AUSTRALIA'S DYNAMIC ELECTRONICS MONTHLY!

MARCH 1985

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Electronics Today INTERNATIONAL

eti

EXCLUSIVE REVIEW: SMALLEST CD PLAYER

SPIES ON SHORTWAVE

SMART LOW-COST PRINTERS

CAPS REPLACE BATTERIES!

GREAT READER OFFERS
See inside

AUSTRALIA FIRST WITH SATELLITE TECHNIQUE

PROJECTS:

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LOW BATTERY INDICATOR

ENHANCER EXPANDS STEREO IMAGE

Now you can afford Trio quality

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PARAMETERS PTY LTD
PERFECTION IN MEASUREMENT

EDITOR
David Kelly

EDITORIAL STAFF
Mary Rennie
Jon Fairall B.A.
Geoff Nicholls B.Sc./B.E.
Peter Ihnat B.Sc./B.E.
Robert Irwin B.E.

ASSOCIATES
David Tilbrook VK2YMI
Jonathan Scott
B.Sc./B.E. (Hons) VK2YBN

DRAUGHTING
David Currie

ADVERTISING PRODUCTION
Danny Hooper

ADVERTISING SALES
John Whalen (National)
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ART DIRECTOR
Vicki Jones

ART STAFF
Sharon Hill
Brian Jones

READER SERVICES
Elizabeth Barnett
Felicity Skinner

ACOUSTICAL CONSULTANTS
Louis Challis and Associates

MANAGING EDITOR
Jamieson Rowe

PUBLISHER
Michael Hannan

HEAD OFFICE
140 Joynton Avenue, (PO Box 227)
Waterloo, NSW 2017.
Phone: (02) 663-9999 Sydney.
Telex: 74488, FEDPUB.

ADVERTISING OFFICES AND AGENTS:

Victoria and Tasmania: Virginia Salmon and Bruce Burrel. The Federal Publishing Company, 23rd Floor, 150 Lonsdale Steet, Melbourne, Vic. 3000. Phone: (03) 662-1222 Melbourne. Telex: 34340, FEDPUB.

South Australia and Northern Territory: The Admedia Group, 24 Kensington Road, Rose Park, SA 5067. Phone: (08) 332-8144 Adelaide. Telex: 82182, ADMDIA.

Queensland: Geoff Horne, C/- The Federal Publishing Company, 25 Balaclava Street, Woolloongabba, Qld. 4102. Phone: (07) 391-4041, (07) 391-8003.

Western Australia: Cliff R. Thomas, Adrep Advertising Representative, 62 Wickham Street, East Perth, WA 6000. Phone: (09) 325-6395 Perth.

New Zealand: Chris Horsley, 4A Symonds Court, Symonds Street, Auckland. Telex: NZ60753, TEXTURE. Phone: 39-6096. Auckland.

Britain: Peter Holloway, John Fairfax and Sons (Australia) Ltd, Associated Press House, 12 Norwich Street, London EC4A 1BH. Phone: (01) 353-9321 London. Telex: 262836, SMHLDN.

Japan: Genzo Uchida, Bancho Media Services, 5th Floor, Dai-Ichi Nisawa Building, 3-1 Kanda Tacho 2-chome, Chiyoda-ku, Tokyo 101. Phone: (03) 252-2721 Tokyo. Telex: 25472, BMSINC.

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Electronics Today INTERNATIONAL

MARCH 1985

FEATURES

PROJECTS

REVIEWS

OFFERS

DEPARTMENTS

ICOM IC-R71A

The Best Just Got Better

IC-GC4
World Clock

ICOM introduces the IC-R71A 100KHz to 30MHz superior-grade general coverage receiver with innovative features including keyboard frequency entry and wireless remote control (optional).

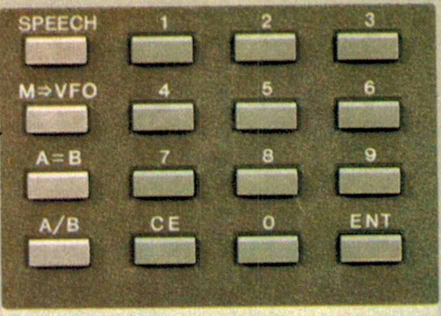
This easy-to-use and versatile receiver is ideal for anyone wanting to listen in to worldwide communciations. Demanding no previous shortwave receiver experience, the IC-R71A will accommodate an SWL (shortwave listener), Ham (amateur radio operator), maritime operator or commercial operator.

With 32 programmable memory channels, SSB/AM/RTTY/CW/FM (optional), dual VFO's, scanning, selectable AGC and noise blanker, the IC-R71A's versatility is unmatched by any other commercial grade unit in its price range.

Superior Receiver Performance. Utilizing ICOM's DFM (Direct Feed Mixer), the IC-R71A is virtually immune to interference from strong adjacent signals, and has a 100dB dynamic range.

IC-RC11
Infrared
Remote

Passband tuning, a deep IF notch filter, adjustable AGC (Automatic Gain Control) and noise blanker provide easy-to-adjust clear reception, even in the presence of strong interference or high noise levels. A preamplifier allows improved reception of weak signals.



Keyboard Entry. ICOM introduces a unique feature to shortwave receivers... direct keyboard entry for simplified operation. Precise frequencies can be selected by pushing the digit keys in sequence of frequency. The frequency will be automatically entered without changing the main tuning control. Memory channels may be called up by pressing the VFO/M (memory) switch, then keying in the memory channel number from 1 to 32.

VFO's/Memories. A quartz-locked rock solid synthesized tuning system provides superb stability. Three tuning rates are provided: 10Hz / 50Hz / 1KHz.

32 Tunable Memories. Thirty-two tunable memories, more than any other general coverage receiver on the market, offer instant recall of your favorite frequency. Each memory stores frequency, VFO and operating mode, and is backed by an internal lithium memory backup battery to maintain the memories for up to five years.

Options. FM, synthesized voice frequency readout (activated by SPEECH button), RC11 wireless remote controller, CK1 DC adapter for 12 volt operation, MB12 mobile mounting bracket, two CW filters FL32 — 500Hz, and FL63 — 250Hz, and high-grade 455KHz crystal filter FL44A.

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ICOM
The World System

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Adgroup ICM 698

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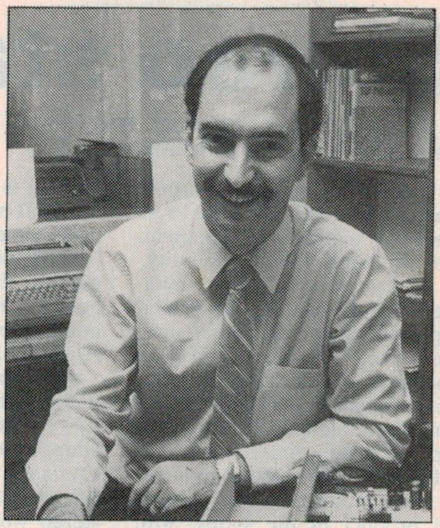
COVER: Picture supplied by Greg Northover oi the Department of Communications.

EDITORIAL



THE LAUNCH OF AUSTRALIA'S first communications satellite in July will herald a brave new era for Australian broadcasting — right? Well some people with a lot of experience in the industry have their doubts.

The satellite could have meant that most Australians would get a new television service. They won't, because the Minister for Communications, contrary to the advice of his department, has decided to have all television signals on the satellite encoded. This is, in truth, to protect the big metropolitan networks from competition by their small country cousins.

The big networks are worried that city viewers will invest $2000 or so in earth stations to pirate signals intended for country viewers. As these Remote Commercial Television Services (RCTS) will have less money to spend on their programmes than the big city stations, not many city viewers will bother.

So what's it all about? It seems like a waste of the money you pay in taxes.

Most, if not all, the television signals on the Australian satellites will be carried using a new transmission system called BMAC (see our feature on page 10). BMAC has many advantages. It provides a better picture as well as several sound channels, it can be used for encoding and for pay-TV.

The problem with BMAC is that it is the design of Scientific Atlanta in the US, which is partly owned by Plessey. Whomever you buy your earth station from, the decoder will have to come from Plessey. All your eggs in one basket!

The Department of Communications has insisted that all the pay-TV aspects of BMAC be kept in the Australian system. As the minister has said that RCTS will not be a pay-TV service, does this mean that country viewers of the ABC will have to pay for the service?

Before the dust completely settles on 1984 there is just one more thing about this last edict from the Department. Someone, somewhere in the Department will have a list of all those with BMAC earth stations. That person will be able to turn off the signal of any desired viewer and in its place put any desired message. Remember Big Brother loves you!

★ ★ ★

By the way we are making some changes in Electronics Today. In future those who write letters to the editor or technical inquiries may see their correspondence in print. If there's something you approve or disapprove of in Electronics Today or in electronics generally, then write!

David Kelly
Editor

SERVICES

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Stereo start — will anyone be listening?

A SHORTAGE of receivers may thwart some listeners now that AM stereo has officially started.

Industry sources confirmed that receivers are unlikely to be generally available until September or October in any quantity.

At present only a small number of manufacturers are geared up to supply the Australian market. Gary Fairweather, Sony's manager of audio products says his company has had AM stereo products stockpiled since January 1984, and expects to move all of it within the next few months.

Pioneer has a limited amount of product in the shops, with more to follow. According to spokesman Laurie Ruddock, Pioneer is responding to events as fast as possible. However, the development of designs for Australia is going to take at least five months. Eurovox and Alpine are believed to have some limited numbers of products available in Australia as well.

Aside from these companies, there are few other takers. Typical of most companies, Sanyo is adopting a wait and see attitude. Company spokesmen suggested that a decision to go on AM stereo would be made in September or October, by which time it is expected the market will have settled down.

Industry sources have been quick to blame the Department of Communications for the lack of products. They claim the department gave no notice of the starting date of AM stereo, announcing a February 1 start date on December 15.

But many broadcasters believe the decision was the right one, and the hiatus inevitable. According to Chris Brammall of Stereo AM Australia, an industry pressure group, the DOC decision was handled correctly.

He said manufacturers were not prepared to introduce products until there was an identifiable market, but a market could not develop until there was something to receive. So DOC had taken the lead.

Predictions are that the drought will last until about September-October. By then many of the sluggard manufacturers will be getting equipment out of the factory. In the interim, it looks as though a small number of companies are going to clean up on the market.

Satellite telephone first for the west

A REMOTE Western Australian gold mine will have Australia's first telephone service via the domestic satellite.

A \$200 000 agreement between Telecom and Bamboo Creek Management Pty Ltd, signed at the Bamboo Creek mine site north-east of Marble Bar, has come eight months before Australia's first satellite is launched by NASA.

Telecom will establish a six channel customer earth station at the mine to provide telephone, data and text facilities as part of its Iterra Network Satellite Service.

The Bamboo Creek earth station will be erected in time for testing via satellite in October 1985 and is expected to be formally commissioned in January 1986.

Communications will be beamed from a 4.6 metre dish antenna at Bamboo Creek to the satellite in a geostationary orbit 36 000 km above the Earth and then down to Bendigo Victoria, where it will join the National Telecom Network.

Contract for Australia's first telephone service via satellite was signed at the Bamboo Creek mine site in WA.

Telecom, with a 25 per cent shareholding in Aussat, the government satellite operating authority, will lease transponder number 13 on the second domestic satallite scheduled for launch next October and expected to be operational in January 1986.

Telecom's general manager commercial services, Dr Laurie Mackechnie, said Telecom was able to provide both fixed customer earth stations on two to 14 channel circuits and also a transportable service which was expected to appeal to a number of exploration, resource and pastoral companies in the outback.

"The signing of the Bamboo Creek agreement effectively launches Telecom's Iterra Satellite Services throughout Australia," said Dr Mackechnie.

Call charges will be set at the maximum STD rate, with different payment options available for customers.

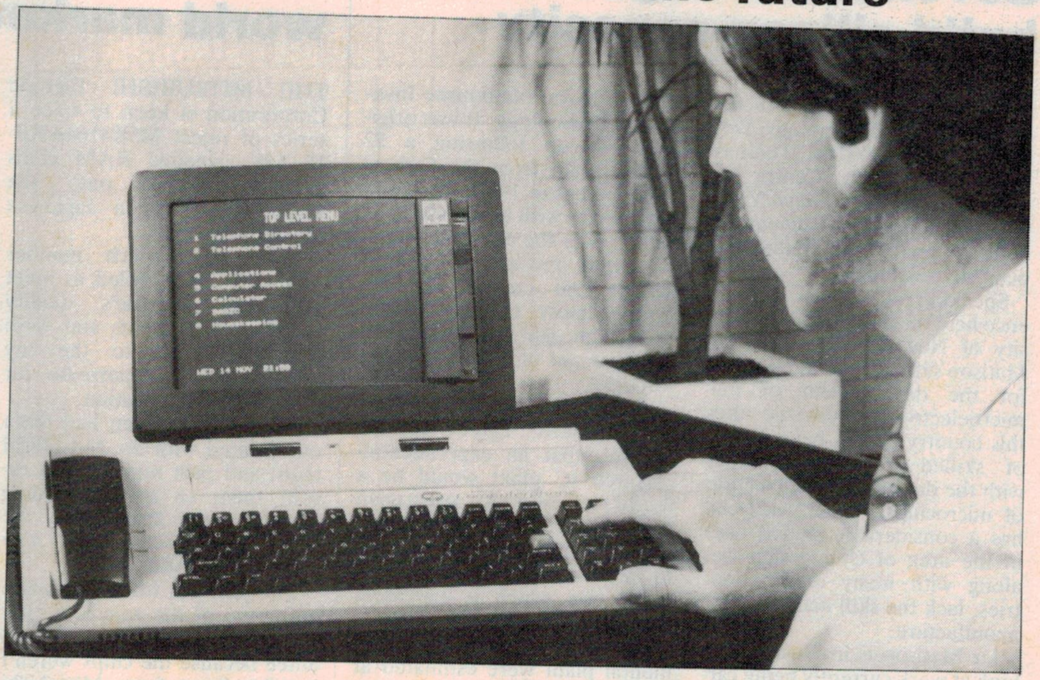
US gets cheaper calls to Australia

GTE SPRINT Communications Corp has begun operational network testing with Australia's Overseas Telecommunications Commission and filed an application with the Federal Communications Commission requesting permission to acquire and operate international facilities for US-to-Australia long distance telephone service.

GTE Sprint expects to offer service to Australia by the first quarter of 1985, at which time Sprint customers will be able to call all areas of Australia and receive discounts of up to 30 per cent from current AT&T trans-Pacific rates to Australia.

GTE Sprint is a leading supplier of long-distance telephone service, provided through its network extending more than 75 million circuit miles across the US.

Computerphone — Telecom vision of the future



TELECOM HAS announced its plan to introduce an all-purpose, easy to use telecommunications terminal for the Australian executive.

Computerphone offers word processor, desk-top computer, data base accessing, videotex, electronic mail and naturally, telephone services in one terminal unit.

It was developed by International Computers Ltd (ICL) of London, who claim the three year contract with Telecom is worth £8m. It is being manufactured entirely in the UK.

Unveiling the preview model computerphone, Dr Laurie Mackechnie, Telecom's general manager, commercial services, listed some of the main features: an intelligent two-line telephone with push button dialling; recall of busy numbers; abbreviated dialling; loud speaking operation; a personal telephone directory that can be quickly displayed for reference; and alternate or simultaneous voice/data calls.

It features a control unit to supervise the following functions: diary and note keeping; word processing; database management system; message passing; access to viatel or private videotex systems; accessing mainframe computers; calculating and spreadsheeting; business graphics; and outgoing telex via telememo. Printer and coloured screen are optional extras.

"There are other technical features," Dr Mackechnie said, "but what I regard as prime customer attractions are that it is easy to use, it is not expensive."

Telecom is the first major user of the unit, according to ICL. Andy Roberts, ICL's business centre manager said recently he expected the Australian market for ICL to be worth over $100m over the next three years.

Telecom is now commencing training for its technical and advisory staff with the launch of 'computerphone for modern managers'. in February 1985.

Place for locals in OTC

OTC, FOR the first time in its 40 year history, recently hosted an industry briefing aimed at increasing Australian participation in the Commission's capital works program. Using its seven satellite earth stations as an example, OTC's engineering director, John Mattes, indicated to an invited audience how local content in such projects could be increased.

At present five satellite earth stations have some local content in the drive grear boxes, terrestrial transmission interfaces and engineering service circuits. The CSIRO has developed new feeds to provide dual polarization capability at Carnarvon (WA) and Moree in NSW.

Mr Mattes identified reflector panels as one of the first areas in which OTC saw a potential opportunity for local engineering firms. This was especially so for antennas in the Ku band which is a developing market. Feed systems for these antennas could be manufactured locally, as would sub-reflectors, other wave guide components and guidance control systems.

Another area identified was Klystron power supplies. While there is little scope for the manufacture of tubes, power supplies are well within the range of local industry.

Opportunities also exist for high power amplifiers said Mr Mattes. Discussing ground communications equipment, he said OTC's requirements alone would not support a local industry but that the Australian market could well do so.

Local market participation in FDM multiplex equipment was already quite strong said Mr Mattes, and that this is likely to increase in the future to support the introduction of digital multiplexing.

Opportunities exist for local participation in earth station management systems. Such systems provide computer based monitoring and control of the station. They include the ability to handle remote, unattended stations; provide analysis to establish original or prime faults; compile periodic reports and provide active control of certain parameters such as EIRP. Local development in this area with customer participation was therefore most appropriate said Mr Mattes.

OTC expects to build six satellite earth stations over the next five years for a cost of around $11m. As part of this requirement, OTC will need 16 low noise amplifiers ($0.3m), 18 high power amplifiers ($5.4m), ground communications equipment valued at $3.7m, multiplexing equipment totalling $1.5m, engineering service circuit equipment to the tune of $1.2m and about $1.5m of station management systems. The total value of these projects weighs in around $25m, but the actual equipment requirements will depend on a number of factors including OTC's traffic growth and the availability of suitable sites.

OTC's immediate needs are for one 18 metre earth station to be located at a site in Sydney. The tender has been split up into components in order to permit greater industry participation.

OTC would consider proposals involving sharing some development costs if they were accompanied by equitable commercial arrangements Mr Mattes said. The current invitation to tender covers a three year period and could extend to: an 18 metre earth station for Sydney, an additional 18 metre earth station, a 13 metre transportable earth station, one or two 13 metre TVRO stations and several standard F stations for Intelsat business services. ▶

Government urged to build silicon capacity

DR JURI MATISOO, director of the Silicon Technology Department of the IDM Thomas Watson Research Centre in Yorktown Heights, New York has urged the government to build a small scale microchip plant in Australia.

Speaking at a press conference held recently at the University of New South Wales, Dr Matisoo said that it was essential for the development of our microelectronics industry that this country should have a pool of skilled personnel familiar with the design and construction of microchips. While Australia has a considerable skilled base in the area of chip design we, along with many other countries, lack the skill necessary for manufacture.

Dr Matisoo is in Australia to look at work currently being carried out by the Joint Microelectronics Research Centre. JMRC is an organization set up by the University of New South Wales and the Royal Melbourne Institute of Technology. It was originally set up following a $2 million grant from the Federal Government in 1982. IBM later weighted in with a promise of $1 million over the next four years.

Current projects at JMRC include the creation of the world's most efficient silicon cells, high gain transistors and development of extensive CAD software.

Professor Graham Rigby, head of JMRC, agreed with Dr Matisoo that an experimental/research IC plant would be a useful addition to Australian capabilities. Currently experimental plant was estimated at to large commercial plants for fabrication which is expensive and time consuming.

Set up cost for a small experimental plant were estimated at around $10 million, versus about $50 million for a full scale commercial one.

Illegal chips on world market

THE MITSUBISHI Electric Corporation is keen to trace a series of reject M5K4164ANP-15 64K dynamic RAM chips illegally released onto the world market by a Japanese toy manufacturer.

The chips, which number around 500 000, failed to meet Mitsubishi Electric's quality control requirements and were sold unbranded to the toy manufacturer, purportedly for a decorative application.

The company then had them overprinted with the Mitsubishi logo, and part number and resold them to several trading houses. From that point, the chips have found their way around the world.

The problem for the ultimate end-users of the rejects is that they don't carry the usual guarantee because the chips weren't bought direct from Mitsubishi Elecrtric.

According to Mr Jon Spence a spokesman for the Australian arm of the company, none of the rejects has yet been discovered in this country, and a large proportion has since been recovered in the United States and elsewhere.

He said that the chips could appear a little dirty from lengthy storage and carry 841809 and 842105 batch marks.

Spence estimated that the toy manufacturer netted a cool $1 million profit from the illegal sale. However, his enterprise is unlikely to pay off because he is now being sought by Japanese authorities.

Anyone finding the chips should contact **Jon Spence** at **Mitsubishi Electric Australia Pty Ltd, 73-75 Epping Road, North Ryde, NSW 2113. (02)888-5777.**

BRIEFS

The Measurement Control Division of Electrical Equipment Limited, after several years at Arncliffe, has moved its head office to North Ryde in Sydney. The new premises will provide extra space for the company's design, manufacturing and service activities. Sales and instrument hire will be conducted from the new head office as well as from branches in other states. The new office is at 8 Lyon Road and the telephone number is 888-9000.

The PA People at Enfield in NSW has started a concert production division to be managed by Peter Twartz and Chris Dodds. Mr Twartz, who has worked in Europe and the US as a production manager, has been a sales engineer at Klarion. Mr Dodds, recently manager of PA People in Canberra, has experience in television and live sound.

Rank Electronics has announced that it will be a supplier of videotex equipment, representing Salora of Finland and Xyllyx of the United Kingdom. Salora manufactures videotex adaptors, desk terminals and editing terminals. Included in the Xyllyx range of equipment will be a coin operated videotex terminal. These intelligent terminals, which can calculate computer time, telephone charges and frame costs, are already in use in the UK and Germany.

Australian computer manufacturer, Webster Computer Corporation, was the only Australian high technology company represented among the 300 exhibitors at the Dexpo West computer show held recently in Los Angeles. Dexpo is a DEC and DEC compatible computer show held twice a year in the US. Managing director, David Webster, said the company's new disc controller attracted considerable interest at the show. The dual-height disc controller is the only one on the market to implement DEC's new Mass Storage Control Protocol.

Tubemakers Process Controls has recently established an office in Tasmania at 67 Lampton Avenue, Moonah, telephone (002)72-6931. David Steedman who has been appointed sales engineer was previously a sales development supervisor with William Adams.

R H Cunningham Pty Ltd has apointed Philip Lawson as its new managing director. Mr Lawson has a science degree and has specialised in developing markets both in Australia and overseas. In another move, David Mason has been appoined to the board as director of engineering. Mr Mason has been with the company for over 12 years. James Cunningham who has established the rental area, particularly in the conference market through the associated company Conference Technology, now becomes deputy chairman of R H Cunningham.

Help applying microelectronics for Australian industry

THE CENTRE for Microelectronics Applications (CIMA) has announced its readiness to offer Australian industry wide-ranging assistance in the application of microelectronic technology to both existing and projected products.

It is widely reported that the use of microelectronics is fundamental to many of the processes and products of Australian manufacturing industry. It is also the cornerstone of the information revolution in which we are currently involved.

Many countries of the world have identified this technology as being essential to the survival and progress of indiginous manufacturing industries.

According to CIMA Australian industry has been slow to both recognise and embrace the philosophy of survival through microelectronics for a number of reasons, some of those being lack of awareness of the scope of the technology, particularly as it applies to their products, current and future; concern at the cost of R&D and the ability to recover those costs in such a small market; the conception that 'state of the art' technology requires large volumes to ensure an adequate return on investment; and the often quoted 'technology cringe', that is, a conviction that Australian business is ill-equipped to compete against the technology giants in America and the Far East.

To address these concerns, RMIT and Technisearch Ltd have been contacted by both the Federal and Victorian State Governments to provide a means whereby the skills and knowledge available within these organisations is made available at minimum cost to Australian industry.

CIMA has been established to provide this service, through a series of seminars and workshops designed to provide management and technology awareness, project developments, and the transfer of the latest microelectronics design techniques, through assistance and guidance in prototype development workshops.

A comprehensive information service, through access to text and data held in libraries throughout the world, is a bonus facility which is offered to participants in the programmes and industry at large.

For further information contact **Trevor Andrews, CIMA, Kay House, 449 Swason St, Melbourne.**

Electric vehicle endurance competition

THE AUSTRALIAN Electric Vehicle Association Melbourne Branch is inviting participation in the 1985 'Electrathon' events to be held at VFL Park, Wellington Road, Mulgrave, Vic on the following dates: 19 May 1985 and 1 September 1985.

Scrutineering will commence at 11 am and the race will start at 1 pm on each of the above dates.

Family and friends are invited and the BBQ advised. There is no entry fee for spectators, the more the merrier.

Novices and professionals alike are encouraged to enter the events. Details of prizes are yet to be announced.

Regulations and entry forms are available from **The Secretary, Australian Electric Vehicle Association, 4th Floor, 126 Russell St, Melbourne, Vic 3000 (03)63-7263.**

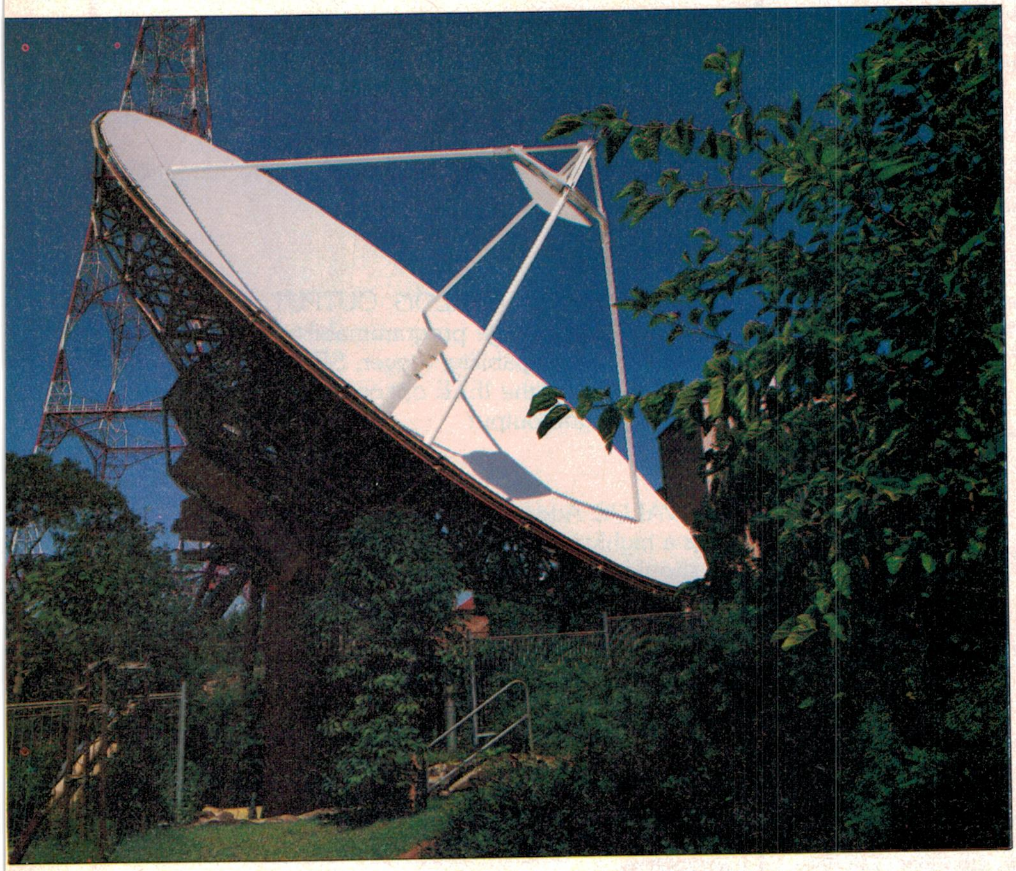
BMAC — WE'LL BE FIRST TO USE IT

The introduction of satellite broadcasting to Australia will change the face of home entertainment forever. It will also bring a new broadcasting standard to TV, the first for thirty years.

Jon Fairall

AUSTRALIA USUALLY copies its broadcasting arrangements from overseas countries. It's a method of doing things that has worked well in the past — enabling us to maximise the service we get from radio and TV, with the minimum R&D investment. On the down side, it means we miss out on the excitement of being on the leading edge.

But that's changing. The countdown of Aussat 1, due for launch in mid-'85, is on course, and on time. It will revolutionise life in rural Australia, and it will bring the cutting edge of broadcast technology into transmission stations across the country.



A large commercial installation like this will send TV signals up to Aussat. It can also receive signals sent to the studios via the satellite.

The reason for all the excitement? After much agonising, the Department of Communications (DOC) has decided to take Australia into the forefront of broadcasting technology by specifying the BMAC standard for TV and radio broadcasting from Aussat. Australia will be the first country in the world to use it, so if BMAC has problems they will be met and solved on the Australian outback.

Origins

Up until now, all TV broadcasting in Australia has been done using the PAL standard. The origins of PAL can be traced back to the original 405 line signal broadcast by the BBC in 1936. The current standard was formalised during the 1950s.

All through the evolution of television the principle has been that the origination of new TV services should not disadvantage people who have invested in the old technology. So, when colour was introduced, people who had black and white sets could still receive the signal. The colour was a bonus added to, not instead of, the existing service.

This principle has been applied to all public broadcasting in just about all areas of development. It's still at work today. For instance, the new AM stereo radio format is completely compatible with existing AM mono receivers.

This is an entirely proper and correct way of doing things. However, it does mean that new technology can be placed in a straightjacket. It seems strange that TV, a gee whizz, hi-tech medium if ever there was one, should be bound by a set of standards three decades old. But such is the case.

Satellites were not going to be any different. The original scheme was for a

satellite system using PAL and capable of doing DBS (direct broadcasting by satellite) over the whole of the Australian interior. In other words, a scheme entirely compatible with existing standards.

But when DOC engineers started experimenting with the system, problems started appearing. It quickly became apparent that, to bring in a PAL signal from a tiny 30 watt transmitter hundreds of kilometres overhead was no mean feat. When technical requirements met economic restraints, it rapidly became impossible.

Pal problems

The biggest single consideration in designing satellite systems is the noise constraint. Because of the great distance involved and the small power of the transponder on the satellite, to receive satellite signals is an exercise in picking faint signals out of the noise.

Unfortunately neither PAL nor its precursor NTSC is designed for use in really noisy environments. There are a number of inherent problems. For a start, they transmit their colour or 'chroma' information on a subcarrier, which is frequency modulated. Frequency modulation suffers from a noise triangle in which the higher the modulating frequency, the greater the noise. But the response of the eye to noise (snow) on the screen has an inverse response, i.e., it's easier to see low frequency noise.

Both PAL and NTSC transmit the chroma subcarrier at the high frequency end of the channel, where it's vulnerable to noise and then demodulates it to low frequencies, where it's easy to see!

PAL and NTSC also have a nasty habit of getting their signals mixed up. Under adverse conditions the chroma can get into the luminance signal. (The luminance signal carries the black and white information. Both chroma and luminance are necessary to create the picture.) The reverse interference process can also occur. These phenomena are known as 'cross luminance' and 'cross chrominance'.

PAL and NTSC have another problem that irks. Blanking takes up too much time. Blanking is the period during which the cathode ray tube is turned off while it retraces to the correct position on the screen. Over 20% of the total transmission time of a PAL signal is taken up with this activity, that is, taken up with transmitting a blank screen.

In the normal course of events we can live with these problems. Modern techniques have done wonders with noise suppression. The waste time in the blanking can be used for captions of one kind or another. But satellites present problems of a different order of magnitude.

MAC

As it turns out, the fact that compatibil-

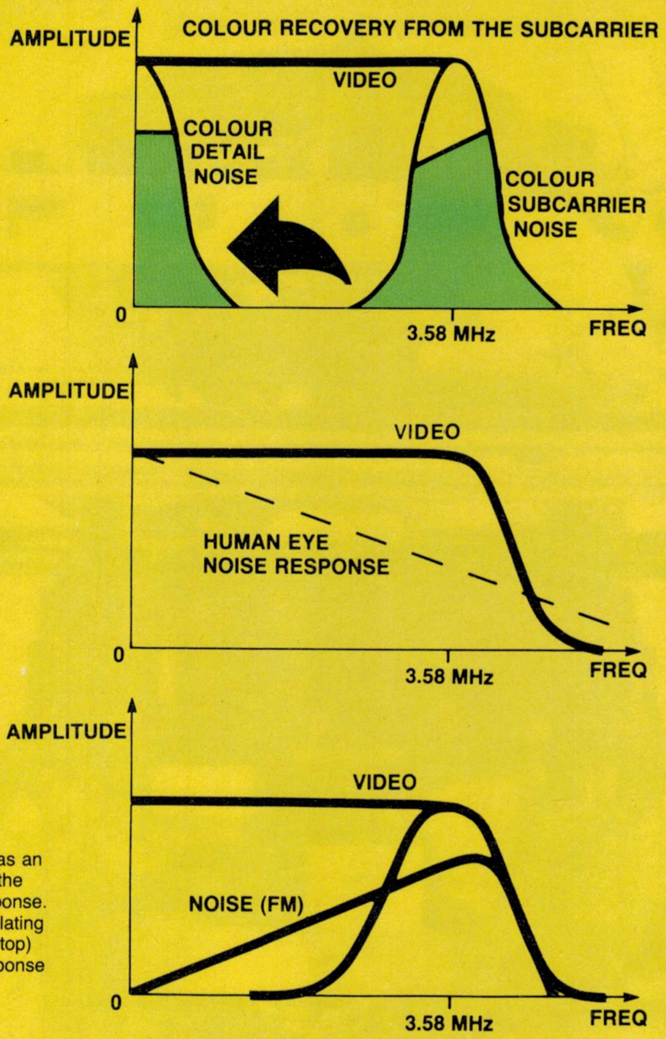


Figure 1: FM noise has an opposite response to the human eye noise response. Unfortunately demodulating the colour subcarrier (top) makes PAL noise response worse.

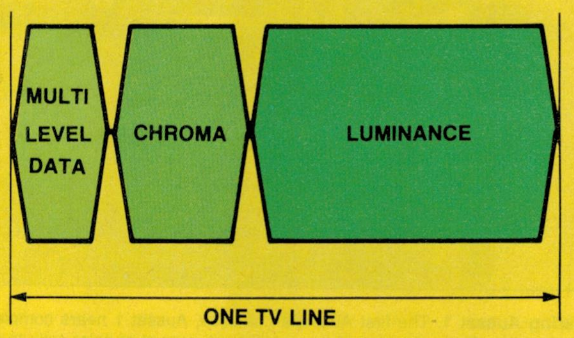
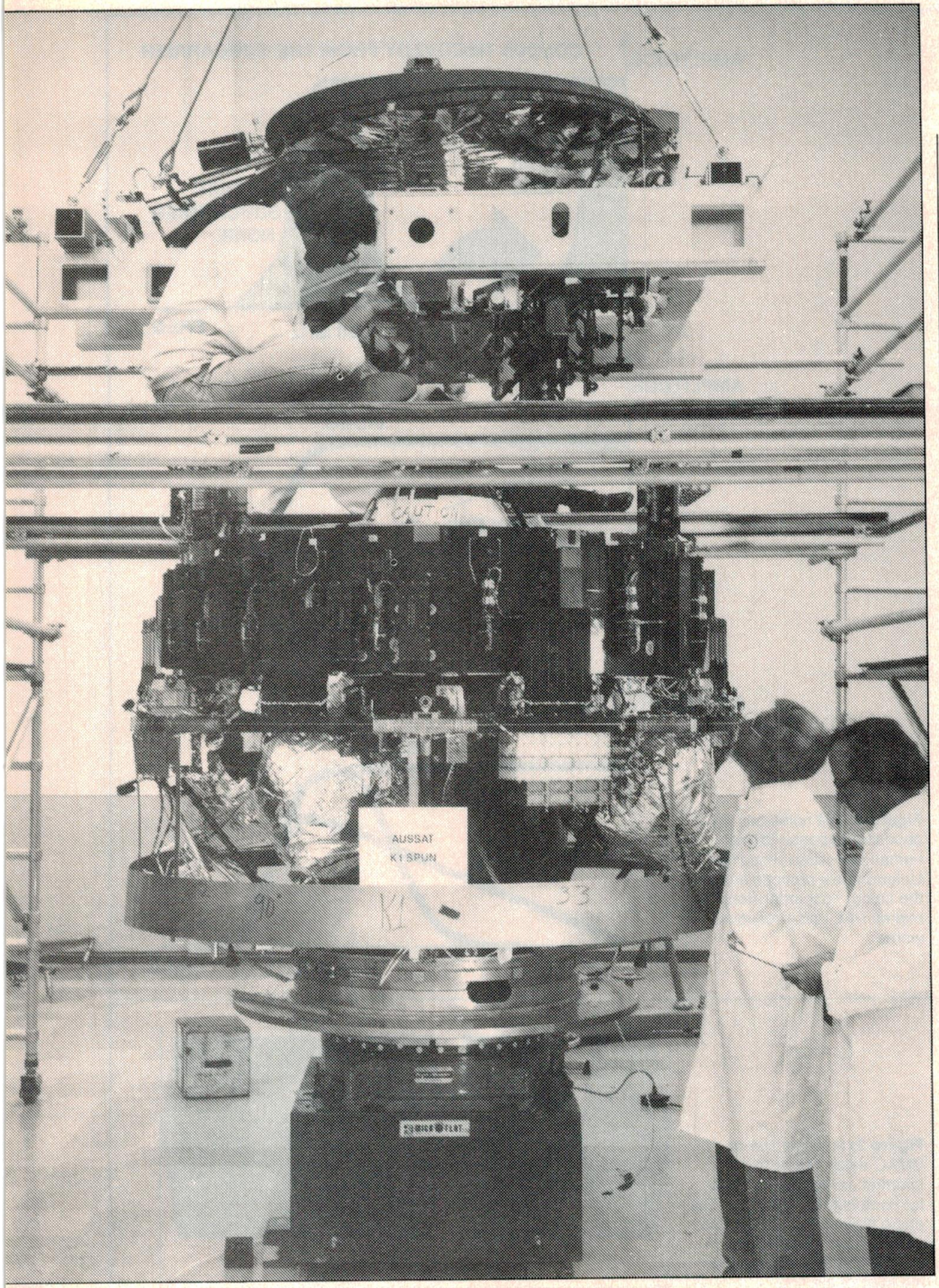


Figure 2: A single line of BMAC data. The chroma information needs two lines for complete transmission. Six audio channels plus one data channel can be contained in the multi level data signal at the start of the line.

	FREQUENCY MULTIPLEX	TIME MULTIPLEX
BASEBAND	A	B
RF	D	C

Figure 3: The four different ways of encoding the sound channels in the different MAC systems.



Preparing Aussat 1. The first Australian satellite, Aussat 1 nears completion at the Hughes Aircraft plant in Los Angeles. The outer skin of the satellite will consist of solar cells to provide power for the electronics. In position the spacecraft will spin on its long axis to provide stability. There is a small despun platform at the top where the earth-pointing antennae will be mounted.

ity is not ecnomically possible with satellite broadcasting is not as much of a problem as it might have been. Firstly, by their nature, satellite systems in Australia will reach an untapped market, so people don't have to junk obsolete equipment. Secondly, the advent of monitors and VCRs has meant that access to RGB input is more important than strict compatibility with any standard.

So, what should we require of a satellite standard? Above all else, it should be cheap. It should also be pretty much immune to noise. It would be nice if it had the ability to carry a decent wideband sound channel. From the broadcasters' point of view it would be even nicer if it had the ability to be scrambled, so that they could have some control over who received the signal. This last requirement may not be endorsed by the viewers of course!

Looking at this wish list, one is inclined to think digital. The problem with a completely digital solution is just one of cost. It's too expensive. Even with the help of VLSI techniques it's unlikely that digital transmission will be cost effective before the 1990s.

The answer to the problem was first proposed by engineers at the British Independent Broadcasting Authority. The IBA came up with a system called Multiplexed Analogue Components, or 'MAC' for short.

MAC is a hybrid digital/analogue time-division multiplexed system, in which the first third of each line is taken up with the chroma information and the second two thirds with luminance.

Complete chroma information is sent over two lines. Information from the first line needs to be stored until the second has been decoded. Naturally, both signals need to be compressed in time, with attendant widening of the bandwidth required to transmit the information.

Sound information is sent in encoded form during the first nine microseconds of each line. There is also provision for a data channel.

In this system sync is provided by a highly redundant digital word at the start of line one of the TV field, and then by a short burst at the beginning of each subsequent line. The system is so good that full picture lock up has been demonstrated with 0 dB signal-to-noise ratio! As a bonus, syncing the picture takes up no more than 0.002% of the total picture time (as opposed to 20% with PAL).

To date, MAC has been produced in five different versions: A, B, C, D and E. They all differ in the way they handle the sound channel. Both AMAC and DMAC frequency multiplex data and audio channels. CMAC is a time multiplexed version. EMAC is a brand new version being developed by Philips, about which no details have yet been released.

BMAC

This is the version of MAC developed by Digital Video Systems in Canada. DVS is a subsidiary of Scientific Atlanta, a US-based corporation that acquired the North American rights to MAC from the IBA. The British company Plessey owns half of Scientific Atlanta.

So, in 1983, when Australia's DOC was casting around for an alternative to PAL, Plessey (Australia) was well placed to offer a system, albeit an untried one.

BMAC multiplexes audio channels at baseband (normal video frequencies) and inserts them into the horizontal blanking period. It uses a four-level digital signal, which makes it possible to contain the bandwidth to 6 MHz but still provide up to six audio channels plus one data channel for command and telemetry.

The audio channels in BMAC were especially designed to be compatible with the very best hi-fi sound available. The system was designed by Dolby with vari-

able pre-emphasis and a delta modulation system.

Pre-emphasis is a fairly standard form of noise reduction in audio engineering. It takes advantage of the fact that the noise spectrum of an FM signal is triangular, i.e., increases linearly with frequency. Before the signal is transmitted, the high frequency component is boosted (i.e., pre-emphasised).

When the signal is received the reverse process takes place and the high frequencies are attenuated by exactly the same amount as they were originally boosted (de-emphasis). In the process the high frequency noise component is also attenuated, so contributing to an overall increase in the signal-to-noise ratio.

In conventional FM broadcasting the amount of pre-emphasis is set by international agreement, and is optimised for typical audio signals with typical noise distribution. This does represent a compromise, however. A better, but more complex solution is available when noise performance is exceptionally important (as here). This is variable pre-emphasis. The signal is sampled before it is transmitted and the amount of pre-emphasis set accordingly. Naturally a control signal also needs to be sent with the audio, in order to set the de-emphasis at the other end.

Delta modulation is a digital system rather like the more conventional pulse code modulation, except that the code does not stand for absolute values of the analogue signal waste form, but for changes in the value of the wave. So instead of sending a multibit word to describe the absolute value of a sample, it is only necessary to send a stream of 0s and 1s to signify whether the signal is increasing or not. Although it is very efficient, this system is limited most strongly by the slew rate of the incoming signal.

The downstation

The DOC has released details of the ways it is prepared to see BMAC used in downstations. One of these is the simple DBS situation.

People wishing to get into DBS will buy a 1.5 m dish antenna, a low noise converter to sit at the focal point of the dish and a satellite receiver.

This latter will contain a Plessey Baseband Processor Unit (BPU), which converts BMAC into RGB, and makes the six audio channels available. It will also have a PAL modulator to turn the RGB plus two audio channels into a high quality PAL stereo signal.

Other schemes will allow an entire community to share the cost of a satellite receiver installation. Under these self-help schemes the community will be allowed to feed the reconstituted PAL signal into a small transmitter for local broadcast.

Another type of self-help project is the community cable distribution type system, intended for situations where the receiver sites are very close together, but also very isolated as a community. A collection of houses on a remote property would be a prime example. In this type of application, the satellite signal is simply down-converted and then ducted through cable to each receiver with requisite amplification and splitting.

This amplification and splitting looks completely transparent to BMAC, so that each receiver will need a baseband converter for turning BMAC into PAL, or better still, using it to feed an RGB signal into a monitor.

In fact, this is an ideal situation, involving the minimum of modulation and demodulation. It also illustrates one of the prime advantages of BMAC: its compatibility with cable. It can exist within the standard channel bandwidth, so it doesn't need any replanning or reallocation of TV channels.

Manufacturing

The market for BMAC is the 650 000 Australians who don't have access to decent TV signals at the moment. To these, add those people in the rest of the country who might be interested in pulling in satellite signals for some variety. At a recent industry seminar it was suggested that this would translate into a possible market for 100 000 units.

Prime beneficiary of this market will certainly be Plessey (Australia), which holds the rights for the development of the BMAC BPU. Plessey intends to manufacture complete downstations at its plant at Meadowbank NSW, and to sell BPUs to any other manufacturer who wishes to buy them for inclusion in his own downstation design.

Plessey has suggested a price of around $450 for the BPU. According to Plessey Managing Director Walter Fielder Gill, Plessey has no intention of capitalizing on its monopoly situation. According to Fielder Gill, the company has a commitment to the government to make rural TV as cheap as possible.

Ivan Trayling, Plessey's Business Manager, has given a categorical assurance that no equipment manufacturer dealing with Plessey will be penalised in terms of price or delivery. He gave an assurance that the development programme for the production version of the BMAC processor unit was on time and on schedule, with first delivery in October 1985.

Within the broadcasting industry support for BMAC has been lukewarm. Engineers in TV stations are pleased by BMAC's technical capabilities but worried by the cost of transmission boards. Only a few months before TV stations must begin installing them there are no firm prices available for the boards, but figures in excess of $350 000 have been mentioned.

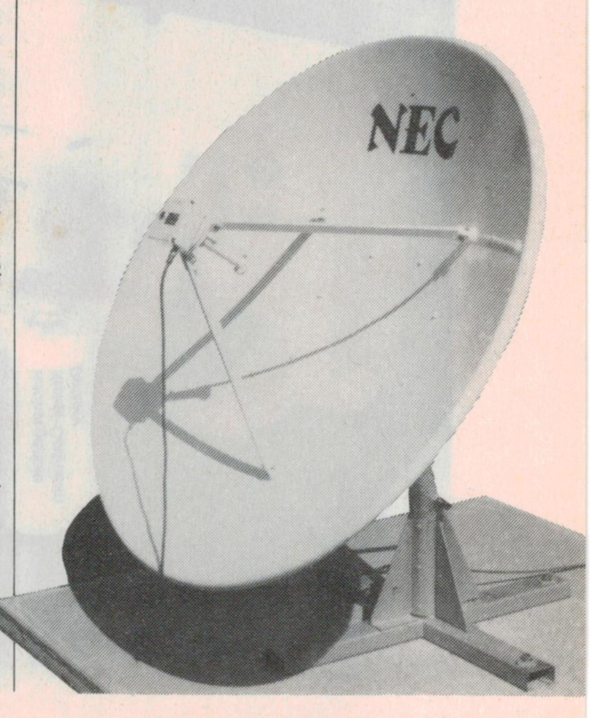
The recent collapse of one of the biggest prospective users of BMAC technology in the USA has also caused a few sleepless nights at the TV stations. Plessey pricing has been based on the assumption of huge production runs in North America. If these do not eventuate, or are delayed for some considerable time, there is a fear that Plessey may have to recoup some of their costs in Australia. If that happens BMAC could start to cost us all a lot of money.

Within the manufacturing industry, reaction to these pronouncements has been one of extremely cautious optimism. There was not much support for the view that complete earth stations will cost only $1520 (a price suggested by the government), but there does seem to be a belief that systems will be available for the minimum possible price. Plessey is talking about $850, excluding the cost of a low noise amplifier and dish antenna. A realistic total figure is probably in the vicinity of $2000.

Many local manufacturers are known to be excited by the opportunities offered by BMAC. Rockwell-Collins in Melbourne, for instance, is studying the viability of a manufacturing operation. Smaller manufacturers are also climbing on the bandwaggon with interest in manufacturing various components. It is likely that the majority of antennae available in this country will be made in this way.

Overseas manufacturers are also interested. Toshiba has plans to buy BMAC BPUs in Australia. It will export them to Japan for inclusion in satellite downstations to be shipped back to Australia.

Since BMAC is also to be used over North America it is quite likely that many Australian companies will be interested in the possibility of exporting equipment to the giant US market. For once they are likely to be ahead of the competition. ●



Pace unveils AM stereo car cassette

Concord Auto Hi-Fi, has recently released its latest model, the HPL 550 car radio cassette player.

The new AM stereo model uses the Motorola system as recommended in Australia for AM stereo broadcast by the Federal Government.

The deck also includes FM using an exclusive Concord feature called FNR, an FM switchable noise reduction option which reputedly gives clean, clear FM performance in areas previously unable to get a clear signal.

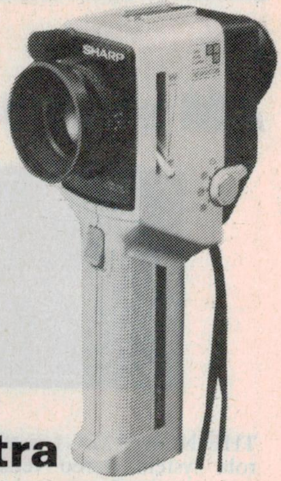
The cassette section has more sophisticated features than are available on many home cassette decks. There are three built in noise reduction systems, Dolby B, Dolby C and DBX, so that tapes prepared for high fidelity listening at home will be quite compatible.

The cassette section is further enhanced by using a dc-servo drive motor for improved speed and wow and flutter control, an amorphous core matched-phase tape head is standard and which the manufacturer claims will last the lifetime of the unit.

The built in amplifier is rated at 25 watts per channel and can be switched to provide two channel or four channel operation with a built in fader control.

At $939 it is not cheap but the owner can be consoled by the thought of a technically advanced deck and a year long warranty.

For further information contact **Pace Enterprises, 4 Clarendon St, Artarmon, NSW 2064. (02)439-8900.**



Ultra compact camera

ALONG WITH VCRs, sales of video cameras are increasing. Sharp's research has suggested to them that customers are interested in a light weight and compact video camera, which Sharp has managed to miniaturize in the XC-54.

Its main features include its design and weight — 0.72 kg, an f 1.5 3 x (10 ~ 30 mm) zoom lens with auto iris, a four position colour temperature selector, through-the-lens (TTL) optical viewfinder, LED indicators for battery alarm, recording start and under exposure, and detachable condenser microphone amongst many other things. It also uses the Newvicon pick-up tube.

Easy automatic video camera

JVC HAS released recently yet another new model video camera — the GX-N7.

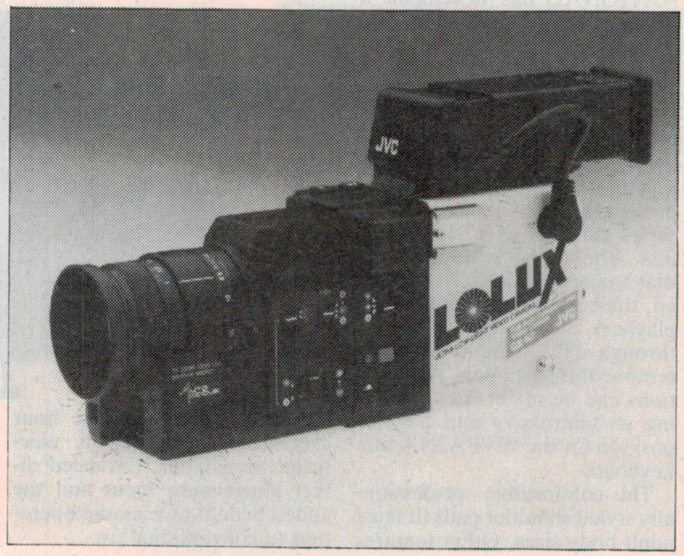
By completely automating all major camera functions, this model frees the user entirely to the creative side of video.

As well as being able to record with a subject illumination of only 10 lux, the three basic operations — focus, white balance and exposure control, are all fully automated. When colour temperature of available light changes a video camera needs to be readjusted for accurate colour reproduction. With most cameras, recording must be interrupted for this adjustment, but the GX-N7 adjusts itself continuously and automatically.

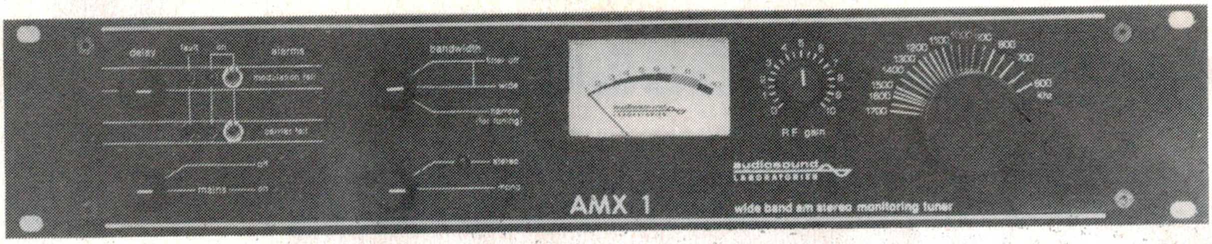
The 6.1 power zoom lens of the GX-N7 can be replaced with lenses from a 35-mm camera. An appropriate adaptor is available from JVC for Canon, Nikon, Pentax, Olympus or Minolta.

Other features of the GX-N7 include: ½" Newvicon tube; lightweight compact size (weighing only 1.1 kg); automatic iris with BLC setting and 6.1 power zoom lens with macro; audio/video fade in and fade out (white fade); built in one point stereo microphone; compatibility with VTRs from other makers; adjustable electronic viewfinder.

For more information, contact **Anthony Toope Hagemayer (Australasia), 5-7 Garema Ct, Kingsgrove NSW 2208.**



AM stereo monitor tuner



THE NEW AMX 1 is a Motorola system stereo version of the AM 102 broadcast monitoring tuner. It features an audio response up to 12 kHz (−3 dB) with two switchable 9 kHz deep-notch Cauer filters (whose responses are only 2 dB down at 8 kHz) to ensure excellent filtering with minimal HF loss. Carrier and modulation fail alarms, balanced line output amplifiers with 40 ohm source impedance and a balanced low noise aerial system (supplied) complement this tuner which should have wide appeal among broadcasting organisations. When used in conjunction with the Audiosound Laboratories PM 1 stereo programme monitoring unit, the AMX 1 forms a complete AM stereo off-air receiver with modulation monitoring.

Also, shortly to be released is a domestic version of this tuner without alarms and balanced output amplifiers but retaining the other technical features such as the deep-notch filters, switchable selectivity etc.

For further information contact **Audiosound Laboratories, 148 Pitt Rd, North Curl Curl, NSW 2099. (02)938-2068.**

Monitor-look colour

SANYO HAS released a new range of 'monitor-look', colour televisions with remote control.

The 34 cm CPP-3010V and the 43 cm CPP-5010V models feature feather touch tuning systems which scan up or down channels. Up to 12 channels can be programmed for fast and simple selection of VHF and UHF channels.

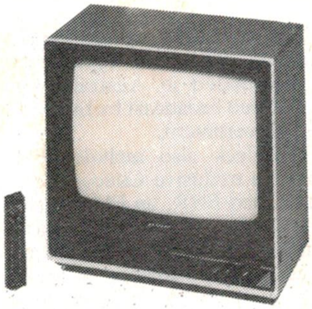
These units feature a sleek, monitor-look design and a smoked glass screen filter for comfortable, glare-free viewing.

These new models also feature 100 per cent solid-state circuitry, a handy infrared remote control unit which fits neatly into the body of the unit and audio/video, input/output terminals to provide great versatility.

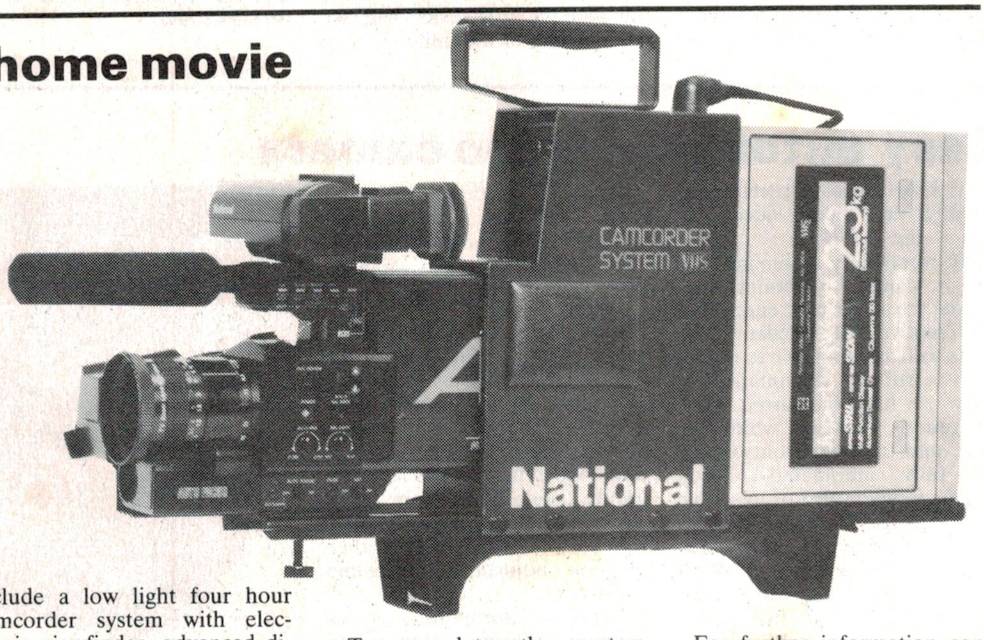
Other features include a built in dipole antenna, earphone jack and digital up/down volume control for precise adjustment of sound level.

Both these models are available from selected electrical retailers and department stores for around $499 and $649 respectively.

For further information, contact **Sanyo Australia Pty Ltd, 14 Mars Road, Lane Cove NSW 2066. (02)428-0822.**



All in one VHS home movie system



NATIONAL has developed a single system VHS filming and recording video unit, the camcorder system.

The camcorder system is a sturdy, lightweight shoulder-frame (WV-SF1N) which has been specially designed to 'dock' together National's NV-180A porta-pak with either of its A series cameras as a single system. The frame is designed so that a tape can be inserted/ejected, the battery can be replaced, playback can be achieved through a TV, without having to remove the porta-pak. All functions can be maintained including an alternative and handier position for the WVPA2NA title keyboard.

The comfortable, professionally styled shoulder pads fit most adult body sizes. Other features include a low light four hour camcorder system with electronic viewfinder, advanced direct image auto focus and the added benefit of versatile operation to conventional use.

To complete the system National has introduced a carrying case with durable aluminium finish.

For further information contact **National Panasonic, 95-99 Epping Rd, North Ryde NSW 2113. (02)887-5315.**

AVERAGE MUSICIANS DON'T OWN A CX5M.

THAT'S WHY THEY'RE AVERAGE MUSICIANS.

The Yamaha CX5M is an extremely versatile computer designed especially for musicians.

And especially for those musicians who are particularly serious about synthesised music.

Professional musicians, sound engineers, composers, arrangers and the like.

The CX5M is one of the new generation MSX computers, the very latest in software and hardware technology.

When connected to your DX7 synthesiser (other synths. subject to available software) the CX5M makes creating the sound you want and programming the sound you want considerably easier. It can be used as a sequencer, edit suite, to compose pieces of music, or operate as a musical instrument independently.

In fact it has 46 synthesised voices already built in.

And all the voices are generated by the superb Yamaha FM system.

Complete with a 3 piece software package, the CX5M also features a built-in MIDI interface, which allows the computer to talk to any MIDI equipment such as synthesisers, drum machines, effects and sequencers.

And the regular arrival of new Yamaha

TREATS IN STORE
— from the Sony D50 CD player

SONY D50 CD PLAYER

Dimensions:	*127 mm (wide) x 401 mm (high) x 134 mm (deep)*
Weight:	*590 gm*
Supplementary ac/dc Adaptor:	*Sony model AC190A 240 volts input, 9 volts dc output at 800 milliamps*
Dimensions:	*100 mm (deep) x 540 mm (high) 570 mm (wide)*
Weight:	*650 gm*
Manufacturer:	*Sony Corporation, Tokyo, Japan*
Anticipated price:	*$399*

Good things come in small packages so the saying goes. The Sony D50 CD player is certainly miniature but a little investigation reveals many things. With a little Sony mastery it surpasses expectations of hi-fi small or large — while still remaining a bit of a Sony mystery.

Louis Challis

IN LATE NOVEMBER 1984 Cathy Gray, the editor of *Sonics* magazine told me with some excitement that a friend of hers had just returned from Japan that day and had brought back the first example of the new Sony D50 miniature compact disc player.

She asked whether I would like to test it and review it before her friend left later that day for other ports?

Naturally I said "Yes" but as is so often the case the promised load did not eventuate.

It was not till mid-December during a visit to Japan that I first caught sight of the D50 as it was pushed over the conference room table for me to examine at Sony's head office in Tokyo.

What I examined was substantially more than just a neat, technically sophisticated and extremely marketable piece of equipment. I perceived what will be the storm troops of a revolution which has gained such a degree of momentum to ensure the early demise of its main opposition.

It is now only slightly more than two years since I first reviewed the Sony CDP101 compact disc player, which was a 'state of the art' development. Of course, anything that is 'state of the art' has to have a 'subscripted date'. The technological developments are now happening so rapidly and embody such tremendous advances, that this year's 'state of the art' advance becomes next year's standard model and is likely to be a superceded model less than a year later.

So it is with the first generation of CDs which you can now buy at auction for much less than half the original price and which you can pick up in Singapore and Hong Kong for unbelievably low prices.

The reasons for this are not hard to find. Between the time of development of the first generation (*circa* 1982 and 1983) and the current generation of new CD players (beginning 1985) there has been not less than one intermediate step for the small manufacturers and up to three discrete technological generations for the larger Japanese and European manufacturers. The explanation comes when you compare the first commercial Sony CD player with the latest.

The CDP101 thus incorporated 43 discrete integrated circuits (ICs), and no less than 49 transistors, and at least 69 other semiconductors. In order to achieve the essential reductions in size, complexity and thus cost, the design of the D50 is based on two primary large (LSI) integrated circuits (see accompanying photo). These have achieved a veritable 'quantum leap' in technological innovation.

But at this point I will leave the background and deal with the primary purpose of the review, which is of course the Sony D50 compact disc player.

The Sony D50 CD

When you pick up the unit you note that it does not look like a CD player, if anything it looks more like fancy packing for some new cosmetics.

The design is based on a rear hinged moulded plastic flip up lid which is activated by a triangular push button at the right hand front top corner of the cabinet.

When this button is depressed the lid pops up 40 mm at the front. If a disc happens to be playing then this automatically switches off the unit. To gain access to the disc well you have to manually raise the front of the cover a further 150 mm. This then provides clear access to the disc well or to the disc if one is already loaded. On removing the disc, the laser assembly can be clearly seen through an elongated slot on the left hand side of the player. A small printed note exhorts the user "never touch the lens". Once loaded the CD disc is clamped between the small central turntable extension and a matching flexible rotating (slave) top clamp element, located on the top cover. It is apparent that some of the concepts developed for the small parallel tracking record player have been used to good advantage in this unit.

The cabinet width is only 7 millimetres greater than that of the CD disc, which is precisely 120 mm. This results in an extremely neat and functional module which has portability as its key feature. The miniscule front panel is divided into two sections. On the left hand side is a liquid crystal display with two associated switches. The display normally (or initially) provides data on the track number and the elapsed time in minutes and seconds for that specific track. By pressing the switch marked "REMAIN" the number of remaining tracks on the disc are displayed, as well as the residual playing time on the disc, in minutes and seconds.

The second miniature switch is marked "MODE" and two designations appear on the liquid crystal display which read "AMS" which stands for Automatic Music Search and "SEARCH". In the AMS mode the FAST FORWARD and FAST REVERSE buttons at the other side of the escutcheon advance or rewind the disc to the start of the next or last track in discrete steps. When the mode is switched to SEARCH you are able to advance or retard the playing position in rapid time so that you can find and listen to the speeded up music and cue to any portion of a track on the disc ready to play normally. As well you can then select the pause position in order to await for an appropriate moment when you may wish to start playing. These facilities of course are duplicating the conventional concepts which Sony initially provided in the CDP101 and subsequently in the latest CDP11S but with far greater ergonomic economy.

On the right hand side of the front panel finished in bright silver are the four feather touch primary controls.

These are the epitome of sensible ergonomic design and achieve maximum flexibility and utility. The largest control is the PLAY/PAUSE control which, if touched once, will start the unit into the PLAY mode. If touched once more this sets the unit into the PAUSE mode. This is very economic on control panel space and I believe it will become the new industry ergonomic standard for all miniature and low cost compact disc players.

To the right of this control are two smaller buttons each with the appropriate double arrow symbols indicating FAST FORWARD and FAST REVERSE. Their precise functions are controlled by the MODE switch located on the left hand side of the front panel. Immediately below these two controls is an elongated STOP button designated by means of a 'square' in the middle of the switch. On the sloping bottom section of the rear panel immediately below the start button is a power ON/OFF switch, whilst below the stop button the edge of a rotary volume control protrudes. The miniature headphone socket is located immediately around the right hand corner of the cabinet close to the lower edge of the module.

On the rear panel there are only two sockets. One is a coaxial 9 volt dc input socket whilst adjacent to it is a 3.5 mm miniature diameter tip, ring and sleeve line output socket.

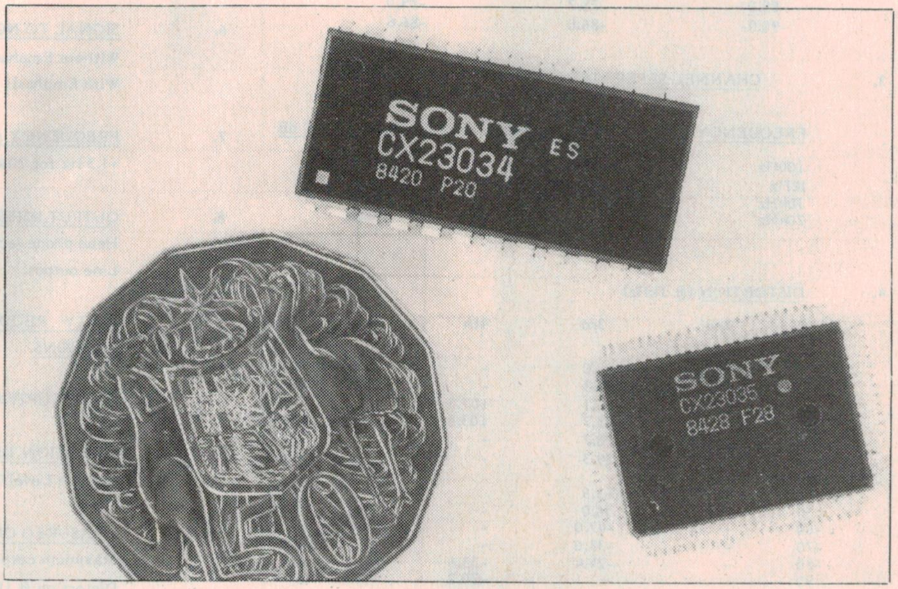
On the inside

It is below the user accessible panels of the unit where the innovative electronics and most exciting features really lie. As the attached photos show, the unit consists of a miniature motor block driving the central spindle and the associated laser optical tracking head. This is powered by a subminiature Hall effect drive motor and amplifier. The individual components are interconnected by means of flat flexible printed circuit cables through to the main printed circuit board of which size and brevity of components positively eclipses the technology of the first, second and even some of the third generation CD players.

The most critical element in this CD player is the flat optical pick-up which is so small and so sensitive that it is worthy of the annual Electronics Industry Award. I am reasonably sure that the D50 will deserve such an accolade when the awards are finally judged at the end of 1985. Although Sony was loath to divilge the secrets of the design, it is clear from my examination of the unit, that the miniaturised sophistication of the azimuth control and its optical depth of field are justifiably worthy of an award in their own right.

The main printed circuit board incorporates the two main large scale ICs together with a large sealed metal electronics block (in which Sony has worked integrated circuit miracles and on which subject they are unwilling to talk). The main printed circuit board has the same dimensions as the unit and lies at the very bottom of the cabinet in the only position available for it. In Japan, the shops are selling the unit with a traylike power supply designated AC-D50. There is also an external battery pack type EBP-9LC and a cord for connecting the unit to automotive cigarette lighter sockets. They have also developed a pack complete with a shoulder strap so that the unit may be used as a conventional 'Walkman' unit with external headphones or ear pieces.

In Australia the unit will be initially mar- ▶



Sony has reduced most of the electronics in the D50 CD player to just these two ICs.

keted with an Australian manufactured ac/dc 9 volt supply of the type described above which provides voltage but no buffering.

Testing

The objective testing of the D50 presented no problems whatsoever as all the normal and important functional user controls are provided. The frequency response of the unit is exemplary being within +0, −1 dB to 19 kHz at which point it rolls over and drops by 8 dB at 20 kHz.

The expanded scale level recordings (using a 10 decibel potentiometer) reveal that there is a little more ripple than I would have expected from the normal level recording. The frequency response performance is nonetheless excellent considering the cost, size and section of the market at which the unit has been aimed.

It is the other objective tests which are usually far more telling. I compared the digital to analogue conversion linearity test results with those measured on the CDP101 only two and a half years ago. The results were almost exactly the same down to −80 dB (that is with 0.2 dB) and were only 1.5 dB inferior at −90 dB (where you can't really hear anything anyway).

The channel separation is extremely good with the measured difference for the left channel from the right channel being well within specifications at both 100 Hz and 1 kHz; and still only 71 dB at 10 kHz.

The separation is still moderately good, but not outstanding at 20 kHz where it is 56 dB (where once again you won't hear anything). The channel separation for signals from the right channel into the left channel is not quite as good but is still impressive.

The distortion performance at the various test operating levels is basically not quite up to that produced by the CDP101. It should however be remembered that the performance of the CDP101 at the time of its release and for up to a year later was not really bettered by any other player. The total performance distortion at 0 VU is 0.0048 per cent at 100 Hz, 0.0033 per cent at 1 kHz and 0.026 per cent at 6.3 kHz. The distortion level at 1 kHz with reducing level does not start to become significant until −70 dB when it climbs to 2.25 per cent after which it rises to 6.8 per cent at −80 dB and 23.4 per cent at −90 dB. The figures, it should be noted, are again close to the performance achieved by the CDP101 which was also one of the best players which we have tested in terms of measured distortion.

The emphasis characteristics of the unit are very accurate at 1 kHz, quite adequate at 5 kHz and acceptable at 16 kHz where the frequency droop in the output of the unit adds to the measured error. The D50 tracks adequately all of the fingerprints tests, the interruption tests from 400 micrometres to 900 micrometres and the black dot test from 300 micrometres to 800 micrometres. It will not track the eccentricity test record with eccentricities greater

MEASURED PERFORMANCE OF SONY MODEL NO. D50, SERIAL NO. 58110

1. FREQUENCY RESPONSE

20 Hz - 20 kHz +0,-1.5dB

2. LINEARITY @ 1kHz

NOMINAL LEVEL	L. OUPUT	R. OUTPUT
0dB	0dB	0dB
-1.0	-1.0	-1.0
-3.0	-3.0	-3.0
-6.0	-6.0	-6.0
-10.0	-10.0	-10.0
-20.0	-20.0	-19.9
-30.0	29.9	-29.9
-40.0	-40.0	-40.0
-50.0	-49.9	-49.9
-60.0	-59.8	59.9
-70.0	-69.6	-69.6
-80.0	-78.7	-79.0
-90.0-	-86.0	-86.6

3. CHANNEL SEPERATION

FREQUENCY	RIGHT INTO LEFT dB	LEFT INTO RIGHT dB
100Hz	-90.8	-116.4
1kHz	-88.5	-92.7
10kHz	-71.1	-71.7
20kHz	-54.9	-56.2

4. DISTORTION (@ 1kHz)

Level	2nd	3rd	4th	5th	THD%
0	96.3	90.0	-	107.7	0.0033
-1.0	96.9	89.3	-	106.1	0.0037
-3.0	98.3	92.1	107.3	-	0.0028
-6.0	-	93.7	103.6	-	0.0022
-10	96.1	98.7	-	-	0.0019
-20	-	89.3	-		0.0034
-30					
-40	-	63.9		-	0.064
-50	-	56.0	-	58.1	0.20
-60	-	-47.0	-	-48.1	0.59
-70	-	-33.0	-	-	2.24
-80	-	-24.4	-33.6	-	6.8
-90	-	-	-20.2	15.8	23.4

DISTORTION (@ 100Hz)

Level	2nd	3rd	4th	5th	THD%
0	92.3	-87.7			0.0048%
-20	-				
-40	69.7	-68.5			0.050%
-60	-45.3			-49.7	0.90%

DISTORTION (@ 6.3kHz)

Level	2nd	3rd	4th	5th	THD%
0	-83.6	-72			0.026%

5. EMPHASIS

Frequency	Recorded Level	Output Level (L)	Output Level (R)
1kHz	-0.37dB	--0.4	0.4
5kHz	-4.53dB	-5.1	-5.0
16kHz	-9.04dB	-11.5	-11.2

6. SIGNAL TO NOISE RATIO

Without Emphasis	88.5dB(Lin) 95.2dB(A)
With Emphasis	95.0dB(Lin) 100.3dB(A)

7. FREQUENCY ACCURACY

+1.3 Hz for 20kHz test signal

8. OUTPUT IMPEDANCE (@ 1kHz)

Head phone jack	51 ohms
Line output	440 ohms

9 DIRTY RECORD TEST AND BLACK DOT READOUT TEST SECTIONS

INTERRUPTION IN INFORMATION LAYER PASSED ALL LEVELS

10. VIBRATION TEST

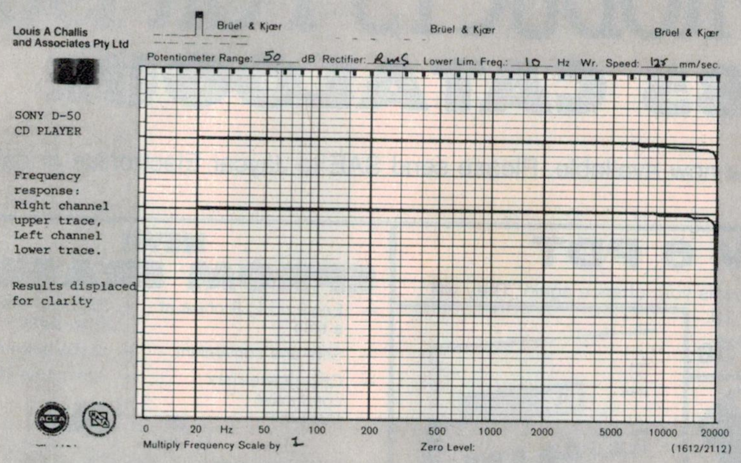
Impulse Level Threshold 0.6"G" Horizontal 0.47"G" Vertical

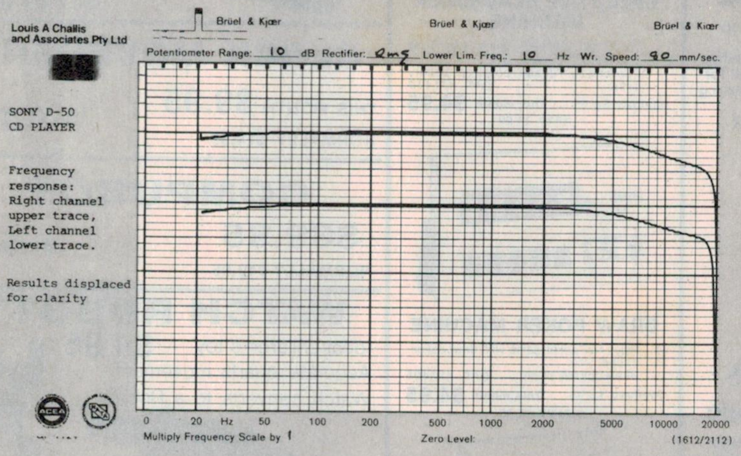
11. MEASURED OUTPUT CHARACTERISTICS OF HEAD PHONE JACK

Maximum output at clipping 0.64V and 12-8mW into 32 ohm load.

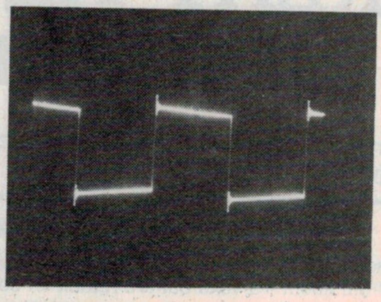
Distortion @ 10mW(1kHz) 0.1%

Sony D50. Audio characteristics as measured.

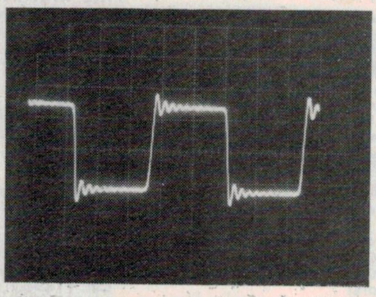




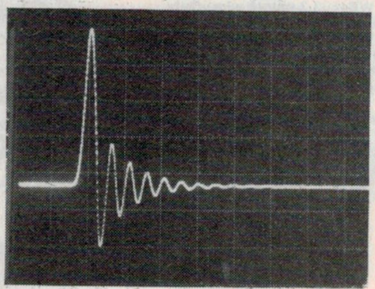
Measured squarewave response of the D50 CD player at 100 Hz and 1 kHz using bands 37 and 38 on Sony test record type 3.



100 Hz



1 kHz



Measured impulse response of Sony D50 compact player.

than 150 micrometres or those with warp angles greater than 4°. But it should be noted that there are not many other players that currently cope with these levels of disc distortion.

The signal to noise ratio is without emphasis and is 88.5 dB unweighted and 95.2 dB(A) weighted. With emphasis these figures increase to a healthy 95 dB unweighted and 100 dB(A) weighted which is really excellent. The frequency accuracy of the unit is exceptionally good having a deviation of only +1.3 Hz for the reference 20 kHz signal.

The square wave test signals reveal the typical digital ringing at the leading edge transition for both the 1 kHz and 100 Hz signals whilst the impulse response reveals a good clean transition with precisely the same ringing characteristics generated by the digital low pass filter.

The vibration tests confirmed that the unit's imunity to steady state and shock vibration is relatively good and that the unit should be capable of performing on all, bar the roughest jogging or worst road conditions if used in a car.

Taken overall the objective test results are both exciting, and considering the cost of the unit, considerably better than required for its 'Walkman' role. They are fully adequate for a true 'hi-fi' role when used as a primary input system for almost any type of home hi-fi system.

The subjective evaluation of this unit was absolutely delightful as I listened to many demonstration discs as well as a number of the latest and best discs produced. They included Status Quo's "Never too late" (Vertigo 800 053-2) which provided a broad range of rock music; Vladimir Ashkenazy's rendition of "Beethoven Symphony No 7" (Decca 411 941-2) and Josef Suk and the Smetana Quartet playing "Mozart's Quintets" (Denon 38C37 7179) which are superb classical discs. One new disc which I played was music by one of my favourite musicians Oscar Peterson and his Trio on "Tristeza" which is now available on CD utilising resweetened analogue recordings *circa* 1970 (MPS 817 489-2). This version is clearer and has more transparent musical content than the microgroove records that I have, and fully justifies the release of this new disc.

As my last series of subjective assessments I connected an external 9 volt battery pack and with some trepidation I used the D50 in the car (when driving), carried it in my camera bag when walking and connected it up at home as part of my normal home monitoring system. The subjective differences between the peformances of this unit and the more conventional and much more expensive CD players which I am currently using or have previously reviewed was quite inconsequential. More importantly the unit coped well with the motion (provided I didn't jog) and provided the road surface was reasonable.

It is discs of this quality played on machines of this calibre which within the next two years will change the very nature of the recording industry, the type of hardware that music is played on and the appearance and type of record shops and outlets with which you have been so familiar.

The signs and signals are clear that Sony has opened 'Pandora's box'. The D50 compact disc player has probably in 'one bold stroke' spelt the doom of the ubiquitous microgroove recording which we have 'used and loved' for almost 30 years.

Bravo, Sony! ●

Amplifiers

TD300 **$510.00**
Slave Amp (150 watts per channel into 16 ohms) with stereo to mono switching.
ZPE SERIES II **$1300.00**
500 Mosfet Output Stages 250W into 8 ohms

Disco Mixers

CITRONIC SM 330 **$695.00**
6 Channel Input (2 Mikes + 4 aux)
ARISTA **$330.00**
6 Channel Input with Equalization.

Lamps

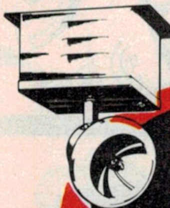
DX60-ES, 240v, 60w **$3.00**
Discolux (soft glass) E.S., assorted Colours Box of 25 – $65.90
G40BC, 240v, 40w **$0.88**
BC Lamps in Blue, Yellow, Orange, Red, Green, Box of 100 – $70.50
G25BC, 240v, 25w **$0.78**
Box of 100 – $62.50
FLOURESCENT TUBES
White $2.30
Colours $6.50
Ultra Violet $25.00
4 ft.

Turntable

CDC 8003 **$225.00**
Direct Drive with Pitch Control
TECHNIC SL1200
Top of the range **$550.00**

Jumbo Strobe

FLA 701 **$153.48**
White Flash Jumbo Strobe with Speed Control.



Helicopter

A GE 4515 lamp in housing can be swivelled and directed up or down spinning 360° in the one place.

RPS 102	2 ARM SPINNER	$198.00
RPS 104	4 ARM SPINNER	$289.00
RPS 106	6 ARM SPINNER	$392.47
RPS 108	8 ARM SPINNER	$497.89

UFO 324 UFO LIGHT (24X GE 4515) $1698.55

Scanner

S101 **$99.45**
Search Lighting effect

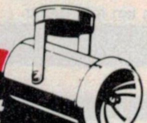
Scanner Bar

S104S **$342.86**
Light bar housing four GE 4515 lamps scanning with individual motors.
All housing complete with front cover and with provision for colour gel.

Micro phones

129B 12" Flexible Chrome Arm, goose-neck $21.55
186C Chrome Base Mount $19.74
518C Soundmaster Mikes $89.75
UD312 Primo Mike $96.95
102 Mike Stand, Adjustable $93.80
HL43U Flexible Arm Mike Holder – $6.99

SMOKE MACHINE, (Great for Special Effects!) $328.00
Fluid — 1 litre $15.00



Pinspot

PS 112S (Par 36 can) $48.94
(6v, 30w) Designed specifically for Mirror Ball Spotting. Used widely to achieve a bullet beam effect.
BONUS OFFER:
Buy 10, Get One FREE!
PS 112L (Par 46 can) $58.99
PINCHASER $480
Exclusively for Pinspots.

Halogen Beacons

WL 104 – $132.59
Warning lights are available in different colours.

Rope Lights

FOR BANDS DISCOS & CLUBS
PRL 803
Rope light, Tubes Red, Blue, Green, Orange, White.
$109.77 each colour
MULTI COLOURED:
White reinforced spiral tube with MC lamps; tred-proof.
SRL 801 – $115.88
Rope Controller
$155.00

Border Lights

BL104 – $163.70
FREE Gel Filter Frame Mount Bkts.

ARTLITE

20th Century plastic in flat sheets (2 mm or 100 mm) or round tubing (8 mm) that glows under ultra violet lighting.
Available in 5 different colours.
Ideal for disco installations and signwriters.
From 50 cents per metre!!!

Disco World pty. ltd.

SHOWROOM:
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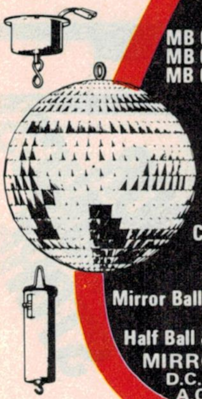
Postal Address:
P.O. Box 509, Lilydale, Melbourne Victoria 3140
Telephone: (03) 735 0588

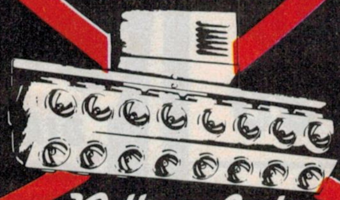
Mirror Balls

MB 005, 5" $13.82
MB 008, 8" $37.20
MB 012, 12" $64.58
MB 014, 14" $93.54
MB 018, 18" $125.34
MB 020, 20" $153.79
MB 012C Mirror Cylinder (12" length) 6" Dia. – $43.18
MB 008H Half Mirror Ball & Motor, 8" – $54.11
MB 012H Half Ball & Motor, 12" – $76.11
MIRROR BALL MOTORS:
D.C. 1.5v Motor – $9.95
A.C. 240v – $29.99



Cosmos Light

Mirror Ball housing 24 x GE 4515 lamps with provision for colour gel spinning in two planes, (vertical and horizontal)
CLG 324 – $1980.68
DOUBLE COSMOS:
Two Mirror Balls in each housing, 12 x GE 4515 lamps.
DCL 212 **$2452.37**
HALF BALL ROTARY LIGHT:
14" Dia. housing 6 x GE4515 lamps. Provision for Colour gel.
HLG 06 **$357.28**



Rolling Light

Metal framed housing rotating 360° in two planes, all with provision for colour gel.
RL 108, 8 x GE 4515 lamps $958.95
RL 124, 24 x GE 4515 lamps (Horizontal) $1985.45
RL 224 24 x GE 4515 lamps (Vertical) $1985.45

CONTROLLERS

AUDIO/CHASER (DW 4LC 4000) **$295.00**
Pre-set Programmed Controller 4 Channels each 1000W.
LIGHT COMPUTER (DW 7LC 4200) **$488.00**
Programmable 7 channel with E-prom (16 programmes). Ideal for Advertising signs and Disco lighting.
VU LIGHT BAR (DW 12 LC 480) **$394.00**
12 channel L.E.D. like display controller. Triggered by sound signals. Exciting new product!
CHASER (DW LC 4000) **$155.00**
4 channel each 1000W with speed & mode switching.
MUSICAL (DW M 4000) **$130.00**
4 channel each 1000W sound to light.
PLEASE NOTE: ALL CONTROLLERS COME WITH 6 MONTHS WARRANTY.

Special Disco Package

1 X SM 330 CITRONIC MIXER
2 X CDC8003 TURNTABLES
1 X 518C SOUNDMASTER MIKE
ONLY $1055.00

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PLEASE NOTE: *Some installation items do not include power cords.*
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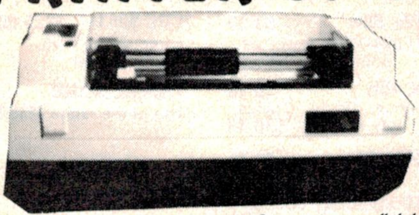

C-9080

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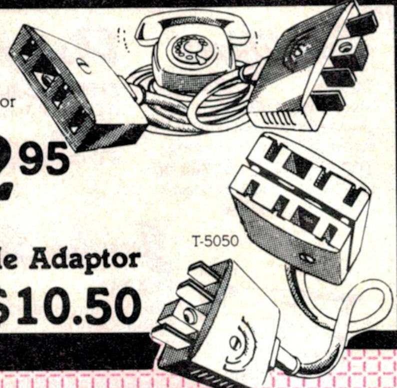
$199

Save a fortune on these printers - Centronics parallel data interface - dot matrix - 204mm fan fold paper.

Telephone Extension Leads Quality 6 conductor

T-5010



NOW ONLY **$12.95**

Telephone Double Adaptor

T-5050

NOW ONLY **$10.50**

PHONE REEL

20 metres of telephone extension lead on hand wind up reel.

ORIGINALLY $24.95

$15.95

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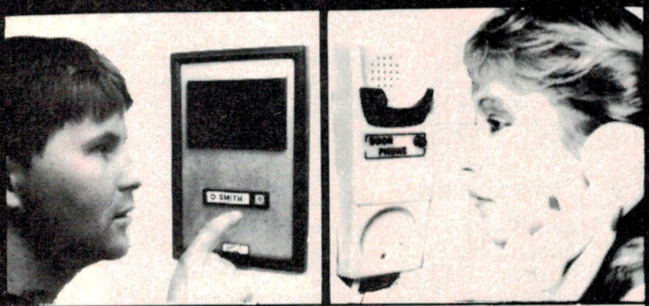
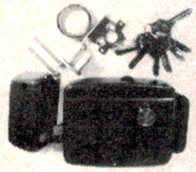
T-5025



DOOR INTERPHONE WITH ELECTRIC LOCK ELECTRONIC PROTECTION

This kit comprises an outside weather proof intercom unit with call button - an inside telephone handset with door release push button - a heavy duty remotely operated electric door lock - power supply, interconnecting cables and instructions.



NOW ONLY **$99**

F-9700

BUY NOW AND SAVE OVER $80

SATELLITE TV GROUND STATION

You can now install your own 4GHz Satellite TV Ground Station for **$3,990** complete. The purchase price includes a 3.5 metre demountable mesh antenna, a 40dB low noise amplifier, a baby Q satellite receiver, a down convertor, full instructions and alignment procedures. 12 months guarantee. For information phone ZAP on **(02) 858 2288.** Cat. X-1000

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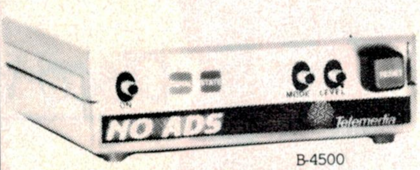
No more ads in your video recordings!



B-4500

$149

Connect to your VCR to automatically edit out advertisements when recording. The Ad-Zapper detects an ad break and through the pause control - stops recording. Playback recording without advertisements.

ZAP'S PRICE

ONLY **$89**

DIRECT IMPORT

Portable Stereo Cassette in red or white

SAVE OVER $20

A-2100

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Printed circuit CAD for IBM PC

TECHNICAL IMPORTS is marketing 'Smartwork', a specialised CAD software package to automate the drafting process in creating printed circuit board layouts.

Both the expert and novice can use Smartwork to create and revise pc board artwork on an IBM PC without tedium. Productivity is enhanced with common symbols such as Pads, Cells, DIP, SIP, normal and fat traces, editing to move any portion of a layout and insert modifications, and full interactive auto-routing.

Using the keyboard, you can place and remove conductor pads and traces. All traces are perfectly vertical, horizontal, or run at 45 degrees. Smartwork ensures that conductor spacing is adequate and line widths do not become too narrow for reproduction.

Drawing output can be in three forms. The first is a one to one size plot on a dot matrix printer using single pass to produce a quick check plot for component layout. The second is a double size plot on the printer using triple pass to produce prototype quality. The third is a double size plot on a pen plotter to give a production quality layout for photo reduction.

System hardware requirements to run Smartwork are, an IBM PC or XT or compatible, with 256K memory, DOS 2.0, IBM colour graphics board and monitor, Epsom FX/MX/RX 100 or compatible, a Houston or HP pen plotter or compatible. A Microsoft or Mouse Systems Mouse is optional. Price is $1250. For further information call **Technical Imports Australia on (02) 922-6833.**

Spectrum analysis from dc to 100 kHz

SPECTRUM ANALYSIS, network testing, modelling and analysis, as well as waveform recording, can be conducted from dc to 100 kHz with just one instrument: the new HP 3562A dynamic signal analyser from Hewlett Packard.

For network analysis high-Q devices can be measured with 1 Hz resolution in one second. Two input channels and a built-in source fulfil the basic requirements for frequency response measurements. Frequency resolution is 801 lines, dynamic range is 80 dB and channel match is +0.1 dB and +0.5 degrees.

The techniques available for measurements with this analyser are linear-resolution FFT, logarithmic resolution or true swept sine-wave.

Block-operation waveform math can be used to normalize network measurements or to compute secondary functions such as coherent output power. Independent X and Y markers speed and simplify analysis of network parameters such as filter bandwidth and slope.

HP 3562A speed and accuracy make possible on-line analysis of distortion, drift, modulation and phase noise. FFT measurement speed lets the user see transient events that a swept analyser would probably miss.

With the fast-setup zoom and flexible markers the user can observe time and frequency traces simultaneously, display a 100 kHz spectrum on one trace and a zoom spectrum on the other, and read signal levels to 0.01 dB using markers. Demodulation allows the user to separate and analyse modulated signals in either time or frequency domain with AM, PM or FM.

For further information contact **Hewlett Packard Ltd, 31-41 Joseph St, Blackburn, Vic 3130. (03)895-2895.**

Universal calibrator now simulates RTD values

TUBEMAKERS PROCESS CONTROLS (TMPC) has announced the release of OhmERO, a new RTD simulator to be combined with its Memocal 81B.

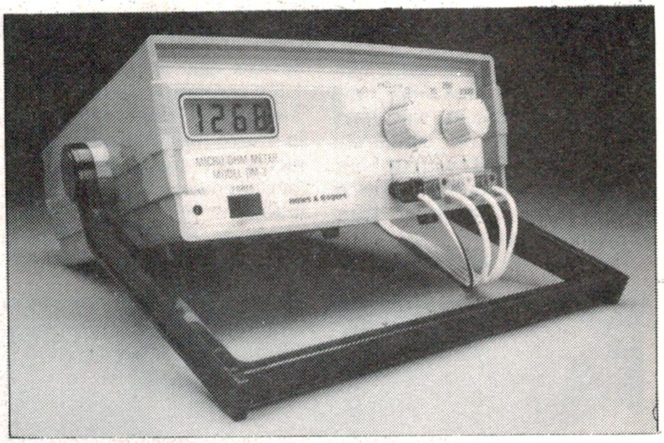
The OhmERO is a plug in accessory for the Memocal 81B calibrator allowing real time simulation of resistance bulb sensors with digital readout directly in °C or °F thereby eliminating the need for cumbersome boxes and look up tables.

Units are normally supplied to DIN 43760 over the range −200°C to 850°C.

The OhmERO facility expands the universal capability of the Memocal 81B to generate as well as measure resistance together with mV, mA and 14 thermocouple curves.

For further information contact **Mr Clinton Burleigh, Tubemakers Process Controls (TMPC), PO Box 381, Granville, NSW 2141. (02)682-0666.**

Digital micro-ohm meter

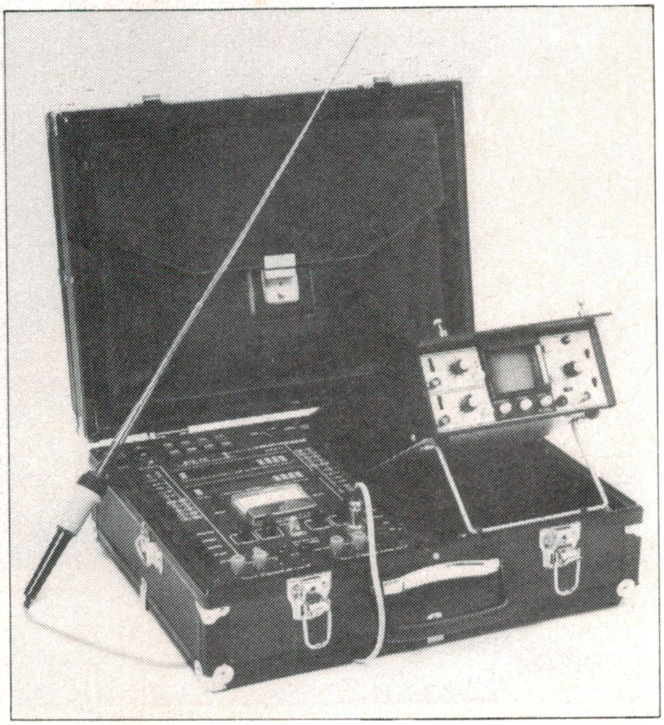


MODERN ELECTRONIC equipment exhibits a continual improvement in quality and specification while becoming less costly.

Hales & Rogers, a small Sydney based design and manufacturing company have made a contribution in this area as well. With the release of their Model DM-2 digital micro-ohm meter, Hales & Rogers have shown it is possible to produce a low volume, specialist instrument with specifications previously only achieved by equipment costing far more. The DM-2 can resolve 0.1 micro-ohms, that's resolving 100 nano volts, with high stability and 0.25% accuracy.

Hales & Rogers are keen to promote the instrument Australia wide and are seeking interstate dealers. Enquiries should be directed to **Bruce Rogers** at **Hales & Rogers Pty Ltd, 17 Mobbs Lane, Carlingford, NSW 2118. (02)85-7540.**

Telephone Analyser



A TELEPHONE analyser which can also perform a multitude of electronic measuring and testing functions, has been launched in Australia by Communication Control.

Designated the ETA 711, the unit can rapidly measure the electrical parameters of both telephones and telephone lines to detect bugs and taps. It can also perform test functions such as voltage, monitor, tone sweep, resistance, capacitance, impedance, current, wire combination, and radio frequency sweeps up to 750 MHz.

Typical applications include field engineering and servicing of minicomputer terminals, microprocessor-controlled products, CCTV systems, cable TV networks, as well as studio and mobile broadcast and recording equipment.

For further information contact, **Communication Concol, Level 1, 11-13 Hartill-Law Avenue, Bardwell Park, NSW 2207. (02)923-2155.** ▶

New light dimmer

LSC ELECTRONICS, the Melbourne based manufacturer of Stage and Auditorium Lighting Control Systems is proud to announce the release of a new compact self-contained dimmer.

To be known as the Quadpak series it is to be available in two versions: the Quadpak 2 and the Quadpak 5.

The recommended list price for the Quadpak 2 is $670 and for the Quadpak 5 is $740.

For more information please contact **LSC Electronics, 728 Heidelberg Road, Alphington Vic 3078. (03)49-2980.**

IN-CIRCUIT EMULATION

In the last few years the technique of emulation has become very widely used in the development and testing of digital systems. This article looks at the principle of emulation, using currently available commercial units to illustrate the concepts.

THE TECHNIQUE of in-circuit emulation (ICE) provides the engineer with a simple, yet effective means of testing hardware and evaluating software in a microcomputer system. Figure 1 illustrates the principle.

The microprocessor is removed from the unit under test (target) and connection made to a second computer system (host) through a dual-in-line plug and ribbon cable. Normally the host computer uses a similar microprocessor to that removed from the target, to imitate or emulate the original processor. At first glance it might seem pointless to remove the original to have it replaced by another in the host, but the technique allows the host to get between the target system and its microprocessor, enabling it to monitor bus activity or to inject signals into the target system.

The technique was first introduced by Intel on their microprocessor development system (MDS) to help debug hardware and software problems encountered during the development phase of a project.

Early development systems were essentially software orientated, providing editors, assemblers, linkers, and, to a limited extent, some facility to execute and debug the final machine code. However, to test hardware and software effectively it was necessary to commit the final code to EPROM before transferring it to the unit under development. Any further debugging that was required was now carried out using a logic analyser. If faults were discovered the engineer returned to the development system to update the software before programming a new EPROM.

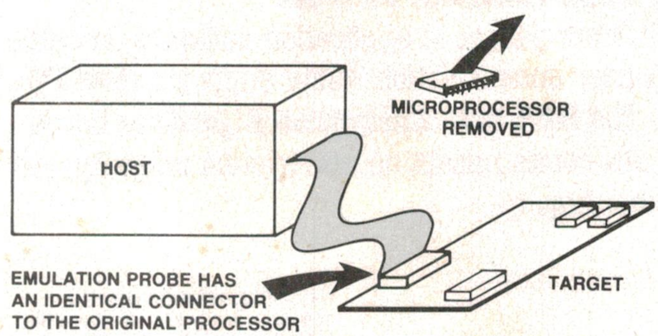


Figure 1. Attaching a target system.

The introduction of ICE shortened this time-consuming procedure, allowing the design engineer to run the system under development directly from the MDS, thus eliminating the need to use EPROMs as a means of transporting software into the target system. Further, since the emulator has access to the target system's buses during program execution, it can also be used as a debugging tool. To help with this task most emulators also provide on-board logic analyser functions.

In-circuit emulation is now a standard feature on development systems with some manufacturers, including Hewlett Packard, Genrad and Tektronix, providing a range of emulators covering a variety of 8-bit and 16-bit microprocessors. However, all of these systems are well outside the budget of most individuals or small companies involved in microprocessor system development. To fill this need several manufacturers, notably Microtek are producing a range of low cost stand-alone emulators that can be driven through an RS232 interface from either a VDU or any popular microcomputer with a serial port.

The value of in-circuit emulation has also been acknowledged by those involved in microcomputer servicing, offering a simple method of injecting test or stimulus programs into a defective board. This can prove an essential facility if the unit under test does not respond to normal keyboard operation or, perhaps, as in the case of some controllers, does not contain a key-

John D. Ferguson

Department of Computer Science,
University of Strathclyde, Scotland

board. Many manufacturers, including Hewlett Packard, the John Fluke Co with their 9010 Troubleshooter and Solartron with their range of Micropods, are now producing test instruments in which emulation is an essential ingredient.

Basic principles

Figure 2 shows a simplified diagram of an emulator's internal architecture. Control circuitry is used to allow either the host computer or the emulation processor to gain access to the target system's buses.

Most emulators are equipped with random-access memory (emulation memory) that can be used to add to, or take the place of memory on the target board (user memory). This extra RAM can often prove useful during program development, providing workspace for software before it is finally committed to ROM.

The procedure of establishing a memory layout for the combination of emulator and target is called mapping. In microprocessor development systems this is normally accomplished from the keyboard during a configuration phase prior to emulation. Simpler systems (e.g. Microtek's MICE) use small in-line switches on the emulator's main printed circuit board.

An example of mapping is shown in Figure 3. In this arrangement the memory space occupied by user ROM has been overwritten with emulation memory allowing the engineer to load and test different versions of software. After mapping has been decided, control circuitry ensures that all addresses established by the processor or host system are directed to the selected memory devices — emulation or user memory.

Normally the target system's own clock

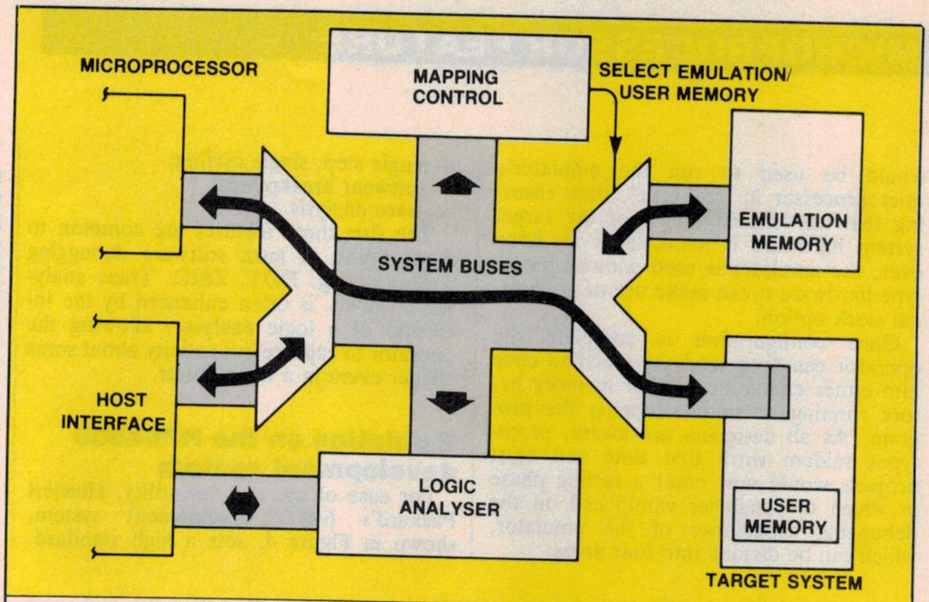


Figure 2. Simplified emulator architecture.

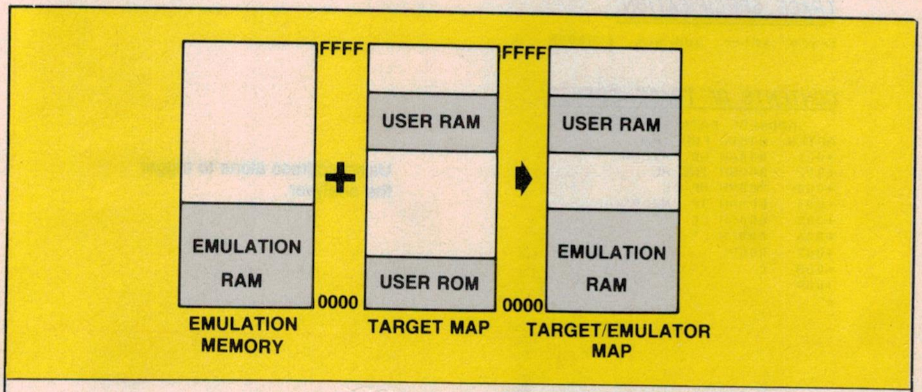


Figure 3. Mapping — constructing memory map for emulation. In this example, 'user ROM' overwritten by emulation RAM, allowing software to be loaded and tested by host system.

Figure 4. HP64000 development system — an example of universal system supporting a range of microprocessor families.

would be used to run the emulator's microprocessor in 'real-time', thus ensuring that any critical timing of the target system hardware is maintained. If, however, the emulator is used without prototype hardware it can make use of an internal clock option.

Once configuration is complete the operator can then load the machine code into either emulation or user memory before running or simple-stepping the program. As all designers are aware, prototypes seldom work first time and most projects would now enter a testing phase in which the engineer would call on the debugging capabilities of the emulator, which can be divided into four areas:

— single step, single cycling;
— softwear breakpoints;
— trace analysis.

The first three features are common to those found in most software debugging packages, e.g. DDT, ZSID. Trace analysis, however, is often enhanced by the inclusion of a logic analyser, allowing the operator to capture bus activity about some trigger event in a trace buffer.

Emulation on the HP64000 development system

For ease of use and versatility, Hewlett Packard's 64000 development system, shown in Figure 4, sets a high standard.

The system offers a variety of options ranging from a stand-alone portable station, for use in the field, to a multi-user, hard-disc based network capable of supporting a wide spectrum of microprocessor families. Multi-user capability greatly eases the problem of integrating software produced by a team of engineers, allowing different areas of a project to be developed independently and yet allowing them to be easily shared between members of the team.

Hardware options available for the 64000 include:

— a wide range of 8- and 16-bit emulators,
— a user-configurable emulator (a novel idea allowing customers to 'build' an emulator for any processor not supported by HP);
— state and timing analysis;
— a range of EPROM programmers.

In common with other systems the operator is provided with a wide range of debugging features for use under emulation. Symbolic debugging, where the operator can refer to program locations using labels defined in the source code, greatly eases use, especially when tracing routines generated by compiling high level language programs written in PASCAL or 'C'.

Depending on your needs (and assets) such a system offers many analysis options starting with a software logic analyser (not real-time) and progressing to plug-in cards that perform state and timing analysis on the emulation subsystem. Fault location with a logic analyser demands flexibility when defining the trigger event, or more completely the 'trace specification'. Figure 5 shows a variety of possible trace specifications highlighting the power of the analyser.

The systems have been on the market now for several years and most of the bugs have been removed. However, a few rough edges still remain, and some typical examples again from the HP 64000 include arithmetic problems evaluating relative jumps when disassembling Z80 code and a rather messy approach to emulating the 8088/8086, where an emulation monitor program has to be linked to and loaded with the user program.

Of the other development systems two families can be identified:

Manufacturer specific. This includes the INTEL MDS and the Motorola EXORmacs development system. Each system will normally deal with all the manufacturer's microprocessors often including devices not yet covered by the 'Universal' systems.

'Universal'. Examples include the Futuredata and Philips systems as well as the HP64000 detailed above. While covering a wider range of processors from different manufacturers, they are less likely to cope with the latest and fastest from any given supplier.

TRACE SPECIFICATION

```
trace after address = 8000H
```

CONTENTS OF TRACE BUFFER

```
      ADDRESS,DATA,STATUS
AFTER   8000H F8H 1FH
+001    0006H LD  A,FFH
+002    0008H INC HL
+003    0009H CP  L
+004    000AH JP  NZ,
+005    0005H LD
+006    0006H
+007    000
+008
+009
+
```

Using address alone to trigger the analyser.

TRACE SPECIFICATION

```
trace only address = 8000H or address = 8100H
```

CONTENTS OF TRACE BUFFER

```
      ADDRESS,DATA,STATUS
AFTER   000CH 00H 1EH
+001    8000H CAH 1FH
+002    8100H CAH 1FH
+003    8000H CBH 1FH
+004    8100H CBH 1FH
+005    8000H CCH
+006    8100H
+007    80
+008
```

Monitoring bus activity as the processor accesses address 8000H or 8100H.

TRACE SPECIFICATION

```
trace in sequence data = 0AAH then
data = 0CCH trigger after address = 8000H
```

CONTENTS OF TRACE BUFFER

```
      ADDRESS,DATA,STATUS
 SEQN   8000H AAH 1FH
 SEQN   8000H CCH 1FH
AFTER   8000H CDH 1FH
+001    0006H LD  A,FFH
+002    0008H INC HL
+003    0009H CP  L
+004    000AH JP  N
+005    0005H
+006    00
+007
+
```

Looking for a sequence on a data bus before triggering and capturing bus details after address 8000H.

Figure 5. Example trace specifications on HP64000.

Low-cost solution — Microtek MICE

Microtek's 'Micro-In-Circuit-Emulator' (MICE) shown in Figure 6 performs many of the functions found on a development system at a fraction of the cost. A range of personality cards allow MICE to emulate most industry standard microprocessors, including the 8088/8086, 68000, 7085, 6809 and the popular domestic processor, the 6502. Two models are available, differing in the size of the emulation RAM and the trace facilities:

MICE I, with 8K bytes emulation memory — not real-time trace.

MICE II, with 32K bytes emulation memory, expandable in blocks of 32K bytes — real-time trace.

Both models are controlled via an RS232 interface, using either a display terminal or a computer system with a compatible port.

Driving a stand-alone emulator from a VDU would only be satisfactory for a small development application or when used in a servicing role (e.g. to check RAM or form signatures of ROM using its on-board test routines). The list of commands, (see Figure 7) includes a line assembler, useful for small routines or when patching a larger piece of software and a two-pass disassembler that generates labels for all subroutine and jump instructions — a nice touch not found even in expensive systems, (see Figure 8).

Serious applications, however, would utilise a host computer system allowing code generated by assemblers or compilers to be downloaded, in either Intel or Tektronix format, to the target system. When a host system is used it requires a driver program to communicate with the emulator.

A range of routines is available for some popular systems:

— Apple;
— any CP/M machine;
— Digital Equipment minicomputers;
— Sharp Personal Computer.

Guidelines included in the manual should allow anyone with a reasonable skill in interface programming to generate a driver routine for their machine.

Trace facilities are good, allowing the operator to perform a real-time forward or backward trace capturing address, data and processor status information in a massive 2048 word buffer. However, there are limitations on the sophistication of the trigger event which is limited primarily to address and status, Figure 9.

To summarize, in-circuit emulation has been available on a range of development systems for several years, where it has proven its usefulness as part of the product development cycle. The appearance of low-cost, stand-alone emulators should widen the appeal of the technique.

A list of suppliers follows. ▶

Figure 6. MICE can be operated from a VDU, or, as shown, from a computer system running a driver routine.

```
>?
ASSEMBLY            A  loc
BACKWARD TRACE      B  [R] addx[c[q]]
CYCLE STEP          C
DISABLE             D  N|I|H|C
ENABLE              E  N|I|H|C
FORWARD TRACE       F  [R] addx[c[q]]
EXECUTION           G  [a1[:a2]]
BREAKPOINT          H  [0[1|2]|1 addx[c[q]]|2 addr]
INPUT               I  port[c[time]]
JUMP                J  a1[:a2]
LIST TRACE          L  |step[a1[a2[q]]]|S[step]
MEMORY              M  [CS|DS|SS|ES] a1[a2[d]]
OUTPUT              O  port d1[d2[d3[d4]]]
REGISTER            R  [AX|BX|CX|DX|SP|BP|SI|DI|DS|ES|SS|CS|IP|FS]
INSTRUCTION STEP    S  [S][c]
TRANSFER/TEST       T  [CS|DS|SS|ES] a1 a2 S|M|a3
UPLOAD              U  a1 a2 [T|I]
RESET               X  [a1[:a2]]
DISASSEMBLY         Z  a1 [a2]
DOWNLOAD            :  (INT)./(TEK)
HELP                ?
ATTENTION           !
>
```

Figure 7. MICE command summary.

```
>Z 8000 8010

LOC    OBJ       LINE   LABEL   SOURCE CODE

8000   200680    0001   B8000   JSR   8006
8003   4C0080    0002           JMP   8000
8006   A904      0003   S8006   LDA   #04
8008   8D1180    0004           STA   8011
800B   CE1180    0005   B800B   DEC   8011
800E   D0FB      0006           BNE   800B
8010   60        0007           RTS

DISASSEMBLY COMPLETED
```

Figure 8. Two-pass disassembler on MICE.

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SUPPLIERS

Alfatron Pty Ltd, 1761 Fern Tree Gully Rd, Fern Tree Gully, Vic 3156-(03)758-9000.
Datacraft Office Systems Pty Ltd, 529 Birdwood Rd, Hawthorn, Vic 3122. (03)818-0741.
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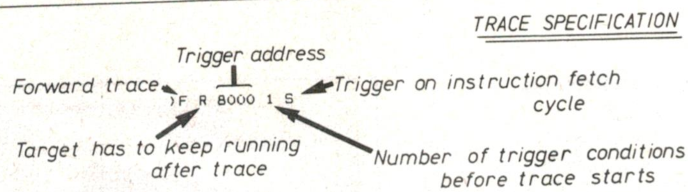
Macro Dynamics, 66 Barry St, Bayswater, Vic 3153. (03)762-6800.
Motorola Semiconductor Products, 666 Wellington Rd, Mulgrave, Vic 3170. (03)561-3555.
Parameters Pty Ltd, 41 Herbert St, Artarmon, NSW 2064. (02)439-3288.
Tech Rentals Pty Ltd, 12 Maroondah Hwy, Ringwood, Vic 3134. (03)879-2266.
Tektronix Pty Ltd, 80 Waterloo Rd, North Ryde, NSW 2113. (02)888-7066.

Figure 9. Trace analysis with Microtek's MICE II.




```
)L
 FRAME IFADDR ADDRESS DATA STATUS SPARE(8 BITS)
  0000  8000    8000   20    S    11111111
  0001          8001   06    R    11111111
  0002          01BA   80    R    11111111
  0003          01BA   80    W    11111111
  0004          01B9   02    W    11111111
  0005          8002   80    R    11111111
  0006  8006    8006   A9    S    11111111
  0007          8007   04    R    11111111
  0008  8008    8008   8D    S    11111111
  0009          8009   11    R    11111111
  000A          800A   80    R
  000B          8011   04
  000C  800B    800B   -
  000D
```

The 'L' command displays the contents of the trace buffer in Hex.

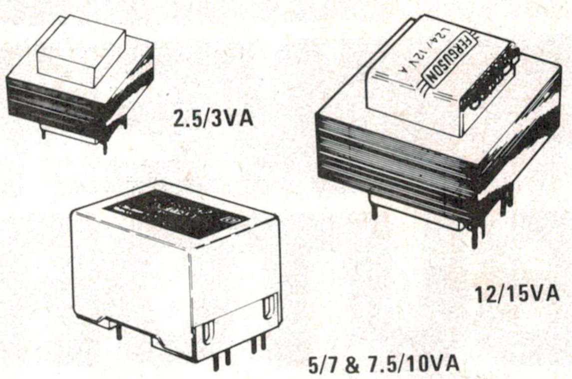
DISPLAY TRACE IN HEX

Adding an 'S' to the 'L' command displays the trace buffer in mnemonic form

```
)LS
 FRAME      ADDRESS DATA     MNEMONIC-CODE
  0000        8000   20       JSR  8006
  0006        8006   A9       LDA  #04
  0008        8008   8D       STA  8011
  000C        800B   CE       DEC  8011
  0012        800E   D0       BNE  800B
  0015        800B   CE       DEC  8011
  001B        800E   D0       BNE  800B
  001E        800B   CE       DEC  8011
  0024        800E   D0       BNE  800B
  0027        800B   CE       DEC  8011
  002D        800E   D0       BNE  800B
  002F        8010   60       RTS
  0035        8003   4C       JMP
  0038        8000   20
  003E
```

DISPLAY TRACE IN MNEMONICS

PCB TRANSFORMERS



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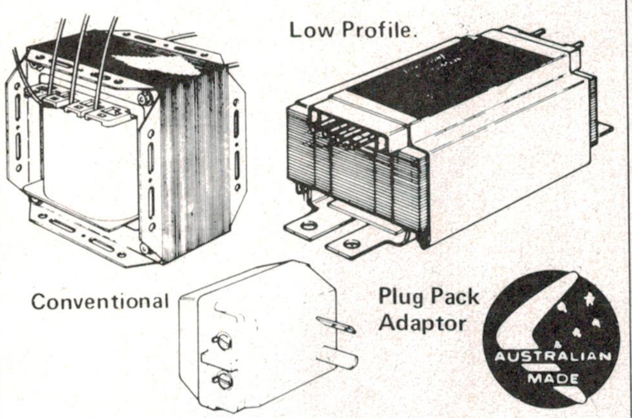

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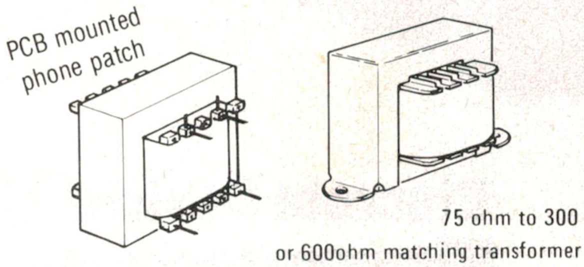

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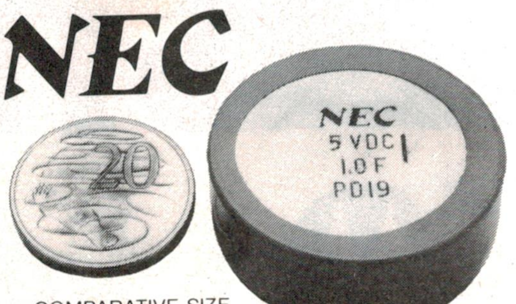
What is better than NiCad for memory back-up?

NEC



COMPARATIVE SIZE

SUPERCAP of course!

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- It never needs replacing or maintenance.
- It does not exhibit discharge memory.
- It can be wired either way. Lack of polarity enables this.
- It can be soldered onto P.C.B.s with other components.
- It can be charged at high and low current rates, i.e. microamps to amps.
- It is completely safe. It will not explode under extremes of temperature, nor will it leak.
- It is small and compact.

Catalogue No.	Cap. (Farad)	Rated V. (V.D.C.)	Max. W.V. (V.D.C.)	Max. ESR* (Ω at 1 kHz)
FAOH105Z	1.0	5	5.5	2.5
FZOH223Z	0.022	5	5.5	50
FZOH473Z	0.047	5	5.5	40
FZOH104Z	0.1	5	5.5	45
FZOH224Z	0.22	5	5.5	25
FZOH474Z	0.47	5	5.5	13
FZOH105Z	1.0	5	5.5	7

*Equivalent series resistance

TECHNICAL INFORMATION AVAILABLE ON REQUEST. JN

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SUPERCAPS

When is a capacitor more than just a capacitor? When its capacitance is so big that the charge it stores can run a circuit for a significant period of time . . .

Jon Fairall

THE SUPERCAP IS HERE. All 1 000 000 µF of it (that's right, one Farad!). Negate your Nicads. Levitate your lithiums. The world of the future belongs to a cap no bigger than a fifty cent piece.

According to NEC, who has announced its release in Australia, the FZ and FA series capacitors will be available in 0.022 F, and 1 F versions. Sizes vary slightly over the ranges but the F2 series 1 F is 28.5 mm across by 25 mm high. And that is just about as big as they come.

The first thing that comes to mind is that a capacitor like this would make a magnificent power backup source. Just how good can be seen from Figure 1, which shows the time taken to loose 10% of the initial charge. As one would expect it depends on the current drawn, but the figures are staggering nevertheless. For instance the FA series 1 F capacitor will supply 10 mA for 50 seconds, or 100 mA for 5 seconds.

Used in conjunction with CMOS technology, where current drain is measured in microamps, the figures are even more impressive. The FZ version 1 F supercap will supply 60 µA for a whole day, while maintaining a voltage above 40% of the original (see Figure 2).

NEC has claimed that a supercap will maintain a 1k byte CMOS RAM for more than 30 days and a µPD7507C microcomputer for more than a day. If it is desired to improve these figures there is nothing to stop a designer connecting supercaps in series or parallel to increase the working voltage or the total capacitance (and thus the backup time, see Figure 3).

As one might expect, the supercap is not the result of ordinary capacitor technology. You don't generate figures like those above by winding up strips of aluminium in plastic tape.

The supercap is an 'electric double layer' capacitor. An electric double layer is the name given to the area around the interface of two dissimilar materials, where charged particles exist. In the supercap there are two materials: an activated carbon and a slightly damp solution of sulphuric acid in an electrolyte. When a charge is applied across the junction, charged particles congregate at the interface. In our case the carbon hosts the positive ions, the electrolyte the negative ones (see Figures 4 and 5).

The charge is actually contained in the ions. NEC claims that the capacitance obtained in this way is between 20 and 40 µF/cm^2. Notice that the capacitance depends on the actual physical area of the interface. If you want large capacitance, you need large areas. At first sight this might seem to mean that large capacitance must lead inevitably to large capacitors, but this need not be necessarily so.

The activated carbon used in the supercaps is specially processed to achieve very high porosity, so that the interface surface area is greatly increased. The same principle is used in air cleaners, where it is necessary to bring a very large surface area into contact with the air. In fact, it is possible to achieve a surface area of 10 000 000 cm^2 with every gram of carbon.

Some simple multiplication will show ▶

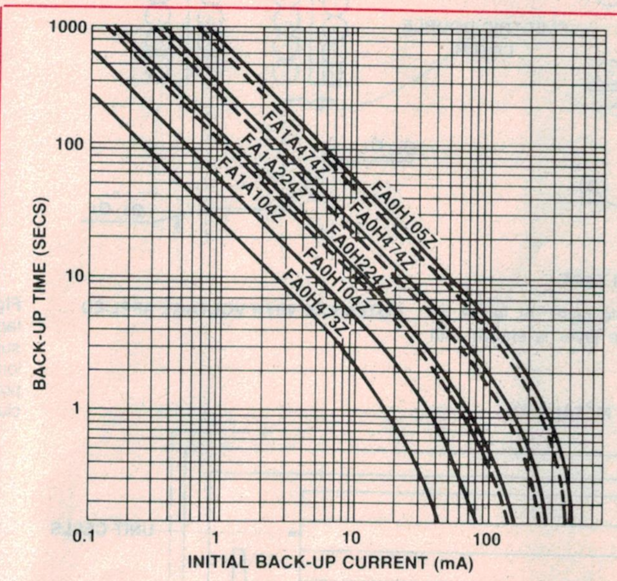


Figure 1: Time versus current as voltage decays from 5 V to 4.5 V.

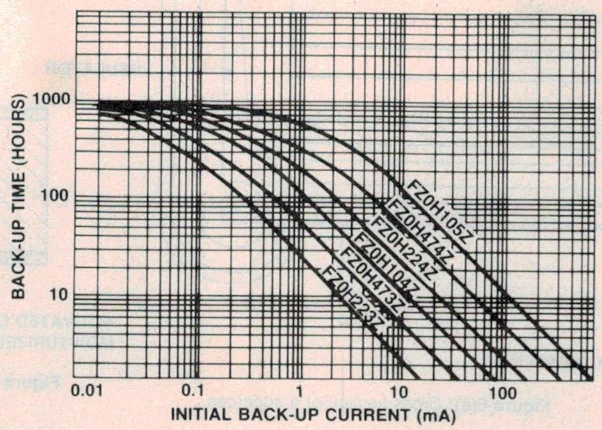
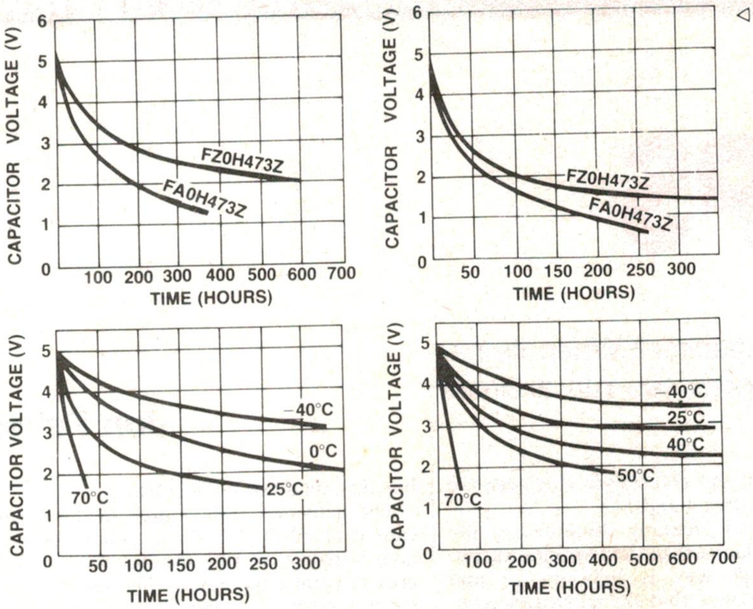


Figure 2: Time versus current for a voltage drop from 5 V to 2 V.



◁ **Figure 3:** The discharge characteristics of the FZOH372Z supercap with a variety of loads.

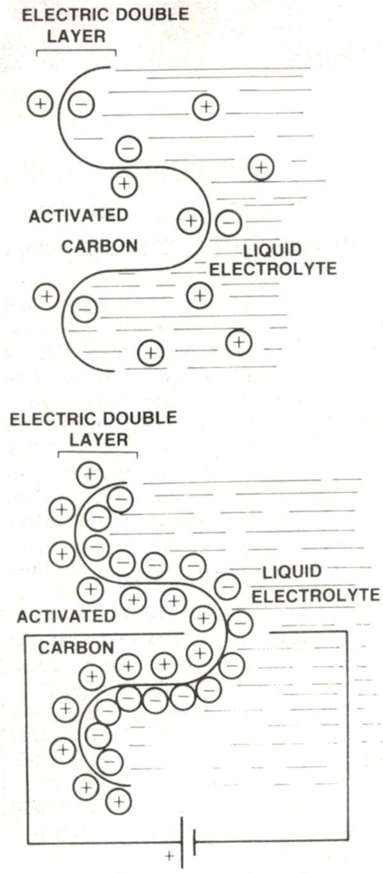


Figure 4: A schematic representation of the interface between the carbon and electrolyte in a supercap. At left, no charge is applied, and the ions are spread throughout the material. At right, a potential exists across the interface and the ions cluster as shown.

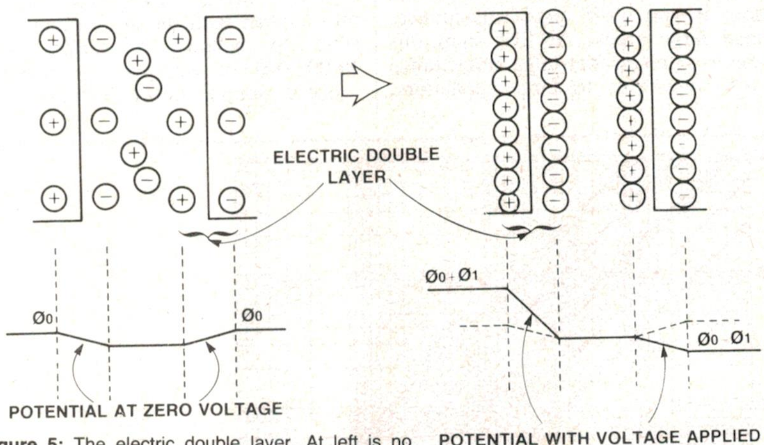


Figure 5: The electric double layer. At left is no potential, at right, the double layer is shown with potential applied.

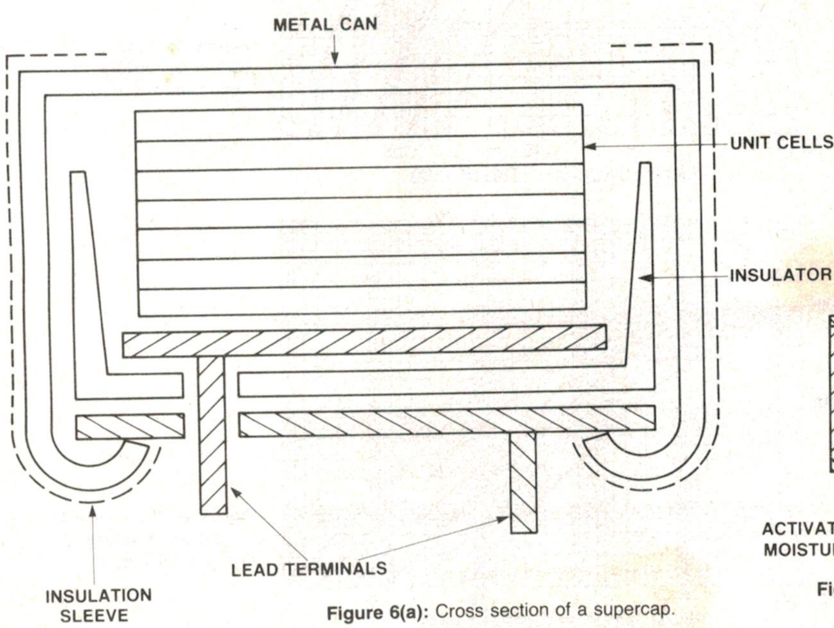


Figure 6(a): Cross section of a supercap.

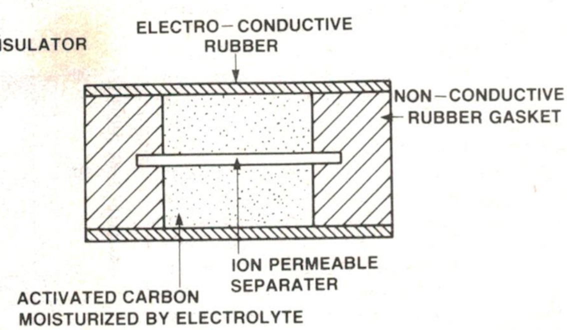


Figure 6(b): A single unit cell of a supercap. Maximum voltage is about 1.2 Volts.

you that this means one gram of activated carbon used in this mode will produce between 200 and 400 Farads worth of capacitance.

In practice, a supercap is constructed rather like a battery, with a number of cells. Each cell has a breakdown voltage of about 1.2 V and the total breakdown voltage of the capacitor is determined by the number of cells connected in series that go to make up the whole unit. Most of the supercaps are rated at 5 V, although a few are rated at 10 V.

Each cell is constructed (see Figure 6) of two layers of activated carbon separated by an ion-permeable separator. The cell is contained in a non-conductive rubber gasket with electroconductive rubber ends (for connection to other cells). The whole unit is vulcanised together to hermetically seal in the contents. To create a working capacitor, a number of these units are stacked on top of each other and placed in a metal can. Contact with the outside world is via two leads that contact with either end of the stack.

The result is a device with many of the desirable features of large capacitors and batteries, without most of their disadvantages. Like a capacitor, the supercap can be charged and discharged as often and as fast as required without any ill-effects. Unlike batteries, there is no need for a special charging circuit and no 'discharge memory' effect.

Unlike both batteries and other large capacitors, the supercap has a life expectancy as long as most of the components it will be associated with. It does not 'dry out' the way other large capacitors do, firstly because each cell is sealed, and secondly because the moisture content of the electrolyte is very small to start with. Unlike a Nicad, its life expectancy is quite independent of the number of charge cycles it has undergone.

Another advantage is that if it does fail, a supercap will usually fail with its leads open circuit rather than short circuit the way most conventional capacitors do. If it is subject to excessive voltage and/or heat, the electrolyte may start gassing (i.e. vapourising). Under these conditions there may be a loss of contact between the electrolyte and the conducting rubber, resulting in an open circuit.

As one would expect there are a number of disadvantages one can point at when looking at supercaps. For a start, they are not suitable in smoothing operations. They have a relatively high internal resistance, and as a result will develop too much ac ripple voltage across them in most smoothing applications.

Another problem is that they are very limited in their maximum working voltage. The decomposition of the electrolyte limits the voltage across each cell to about 1.2 V. In theory it is possible to stack as many as one likes in series to create as high a working voltage as required. However there are impediments to developing this idea to the nth degree. As the number of cells increases so does the series resistance, and so does the physical size of the capacitor. For this reason NEC has decided to restrict construction to 5 and 10 V models.

From the point of view of the manufacturer there is a further disadvantage, namely that both solvents and ultrasonic cleaners may have bad effects on the capacitors. Both these cleaning methods are in common use after boards have been through automatic insertion and soldering equipment.

Figure 7 shows the standard method of using a supercap as a power backup. Resistor Rc is a current limiting resistor, and should be defined by the maximum current capacity of the power supply. At the start of charging a supercap will draw 50 mA. (It takes about fifteen minutes to charge to within 0.4 V of the power supply.) The diode is used to decouple the capacitor from the power supply in the event of the latter's failure. The only other consideration that one needs to bear in mind is that for maximum usefulness the supercap should be placed as close as possible to the device it is going to sustain.

Supercaps necessitate a complete rethink of the way designers attack the problem of backup power. They do not provide the total answer, if only because of their limitations on voltage. But for most computer applications, they represent a significant step forward. ●

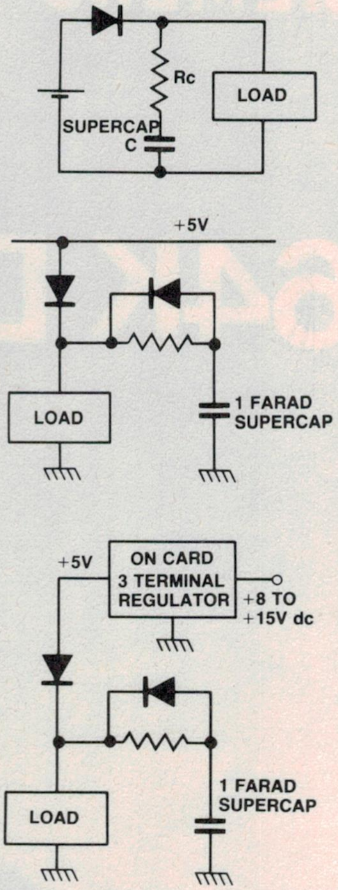
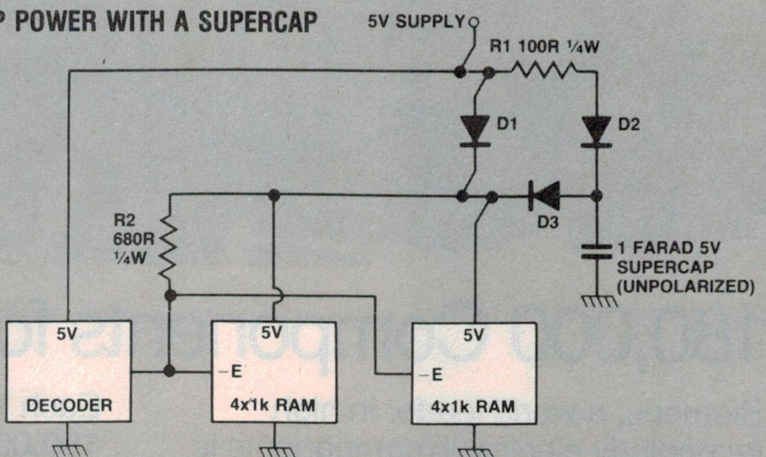


Figure 7: Three possible back up configurations.

BACKUP POWER WITH A SUPERCAP



A 1 F supercap draws 50 mA at the start of charging. Diode D3 isolates the RAM chips from the voltage across the capacitor as it slowly charges. It takes about 15 minutes to charge within 0.4 V of the supply voltage.

The diodes are Schottky types that offer low forward resistance and low reverse-bias leakage current. When power fails, the power supply is isolated from the supercap by diode D2 and from the RAM diode D1. The decoder goes high, ensuring that the RAM will not be selected during power failure (supercap holds the chip-enable line high). Resistor R2 must be small (680 ohms) to hold up the decoder output stage, because the pull-down transistor turns on (briefly) and draws a little current during power shutdown.

All RAM address, data, and control lines (except chip enable) should be held low by 4.7 k resistors during power-off to prevent the input stages of the CMOS RAM devices from drawing high current. A power-detect circuit and appropriate software could be included to ensure that RAM is not being written to when the power fails.

Better performance for Z80 software

THE NEW Z800 Microprocessor can be used to upgrade existing Z80 software increasing its performance up to 12 times — with no program modifications.

The Z800 Family provides both an 8-bit non-multiplexed bus design (compatible with the Z80 device) and a 16-bit multiplexed bus design (compatible with the Zilog Z8000 Family).

On-chip features improve performance. Cache memory and other on-chip peripherals plus an enhanced, high performance instruction set allow the Z800 CPU chip to operate at up to 25 MHz and to execute one to five million instructions per second.

An on-chip Memory Management Unit (MMU) extends the Z800 CPU's logical addressing space to up to 16M bytes. Borrowing a successful strategy from popular 16-bit minicomputers, the MMU divides the Z800 addressing space into pages that are then mapped into the larger physical memory space.

A 256-byte, on-chip memory cache gives the Z800 processor high-speed access to instructions and data that usually are kept in external memory. As a result, the Z800 CPU can operate efficiently with a wider variety of memory devices — including those operating at a much lower speed.

Built-in peripherals reduce system space. The Z800 CPU provides four DMA channels, three counter/timers, one timer, a universal asynchronous receiver/transmitter (UART) an interrupt controller, a dynamic RAM refresh mechanism, and a clock oscillator.

The Z800 processor contains the entire Z80 CPU instruction set plus additional enhancement, hardware multiply and divide, 16-bit arithmetic, 16-bit load and system call, test and set. A special group of extended processing instructions allows the device to operate with Zilog's new Z8070 floating-point processor.

Separate operating modes protect time-critical tasks from background tasks. Like the Z8000 CPU, the Z800 processor separates system and user modes to run the operating system and application tasks, respectively. As a result, the Z800 processor isolates and protects time-critical tasks from disruption by user or background tasks when working in a multitasking environment.

For further information contact **The George Brown Electronics Group, 174 Parramatta Road, Camperdown, NSW 2050. (02)519-5855.**

Utilux explains 'Le Pin'

THE PRECICONTACT PIN, a two-piece construction with a tapered entry socket for easy insertion of IC legs, is becoming available in an increasing number of configurations. According to its Australian distributors Utilux Pty Ltd, it is one of the best available for precision IC sockets and components.

'Heart' of the pin is a four leaf beryllium copper contact which component accommodates 0.20 x 0.38 mm to 0.38 x 0.53 mm leads. The contacts are burnished and plated all over in controlled batches which the maker, Precimont, claims ensures quality control, reliability and resistance to corrosion. The brass sleeves are also precision made and have closed end construction which eliminates solder and flux wicking problems.

Utilux has announced release of a number of sockets using the Precicontact Pin which includes UH high temperature sockets, LED sockets and pin grid array sockets.

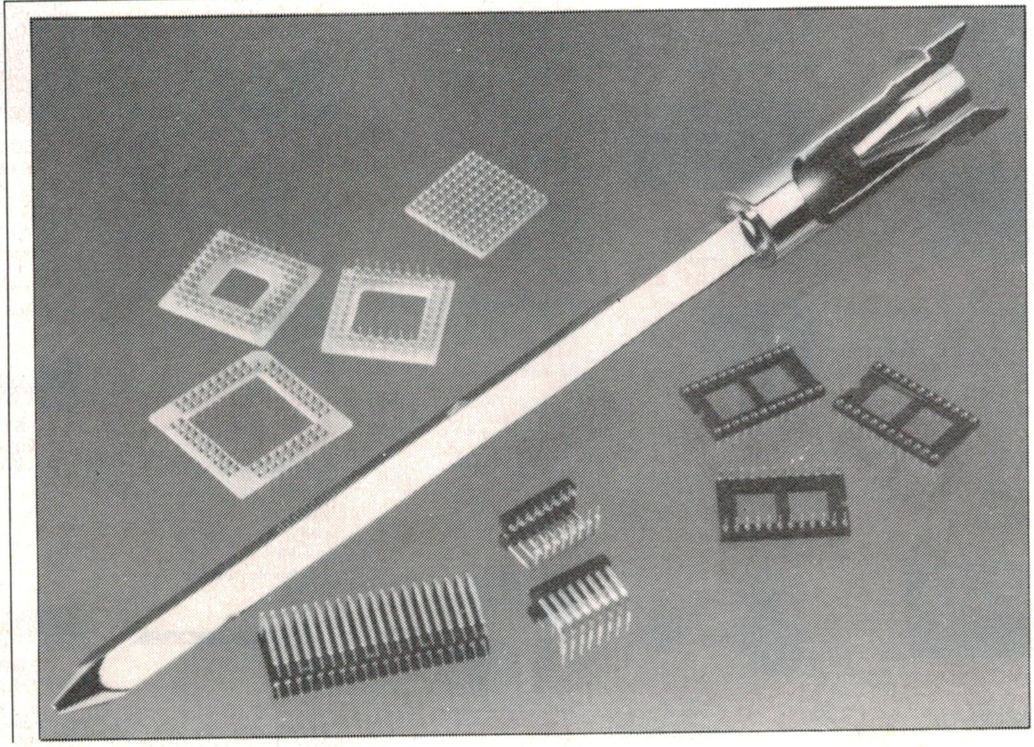
The series UH high temperature sockets are of the open insulator type available six to 40 ways. The pin housing is made from glass filled polyphenylene sulphide UL-94V-0 and the socket is claimed to meet the severe environmental operating conditions, with an operating temperature of −65°C to +250°C.

The new LED sockets (Series LED) use the Precicontact Pin and are also available in six to 40 ways, in a housing of glass filled polyphenylene sulphide UL94V-0.

A new range of pin grid array sockets is available in a larger variety of configurations with either solder or solderless wrap tail terminals. The pins are housed in glass epoxy, GIO, 1.57 mm thick and are useful as working tools for construction of bubble memory banks for computers and microprocessors and for bread boarding and prototype build programmes.

Further information contact **Utilux Pty Ltd, 74 Commercial Road, Kingsgrove NSW 2208. (02)50-0155.**

The Precicontact pin. It is available in a range of sockets including high temperature sockets, LED sockets and pin grid array sockets. Its plated design improves reliability and resists corrosion. ▼



Multi-tap power supplies for 3-12 volts

THERE ARE several ways of reducing the high cost of replacement batteries. One method is to use rechargeable batteries of the nickel cadmium type. These offer extremely good performance and long life as they can be used and re-charged up to 1000 times.

Another way is to run products from 240 volt mains electricity via a battery eliminator. This provides the correct voltage and current and has the added advantage that no detioration in performance is experienced as happens with batteries from the moment they are installed.

Arlec Pty Ltd has just introduced a new plugpack battery eliminator under its Part No. PS699 which will power the majority of small battery operated products on the market.

Because it is a plugpack, the battery eliminator itself plugs directly into the 240 V mains socket thus keeping the installation simple, neat and tidy. The supply lead is fitted with a modified cruciform plug which provides a choice of six different connectors to suit the majority of input sockets fitted to different manufacturers' products.

A switch on the plugpack selects any one of the six voltages available (3, 4.5, 6, 7.5, 9 and 12 volts) and the 500 mA current capability is usually more than adequate for the items to be powered.

The new in-line polarity reversing plug is the subject of a patent application.

Further details on the PS699 battery eliminator and Arlec rechargeable batteries are available on application to **Arlec Pty Ltd, 30 Lexton Road, Box Hill, Vic 3128. (03)895-0222.**

A new low-profile, double-pole switch

BURGESS HAS announced a new, low-profile switch, designed and developed with the current vogue in slim-line telephones in mind.

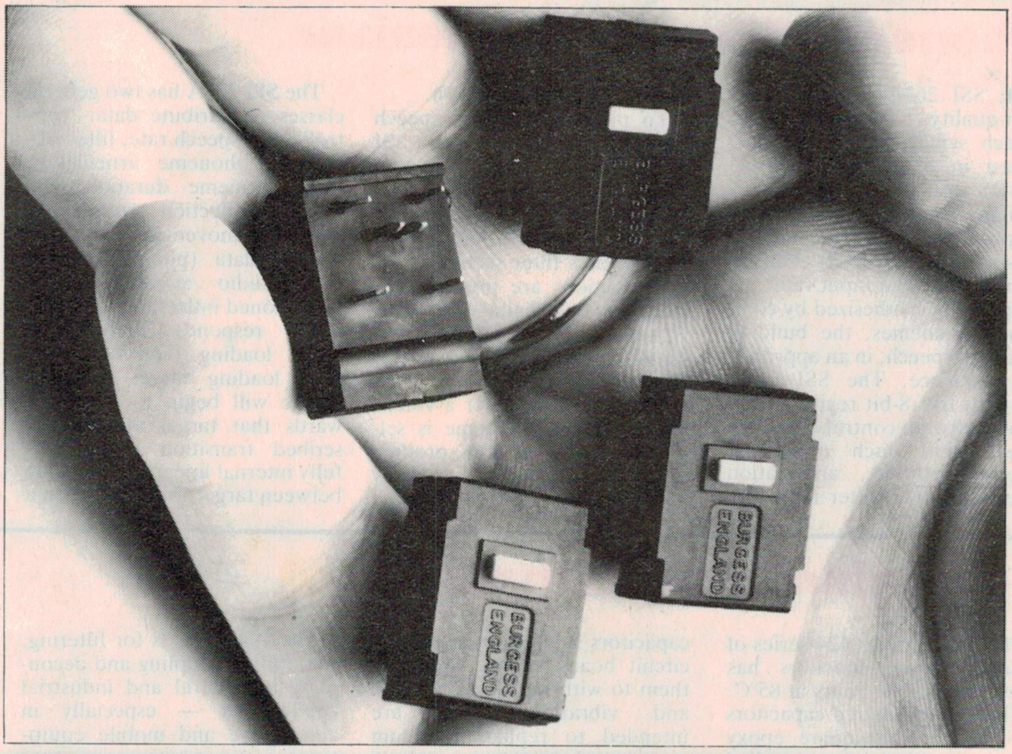
Based on the Burgess V4 mechanism, the new switch is double-pole and has changeover or single-throw options; the electrically isolated circuits are actuated by a common plunger. Terminals are suitable for pc board mounting and are spaced on the international 0.1 inch grid.

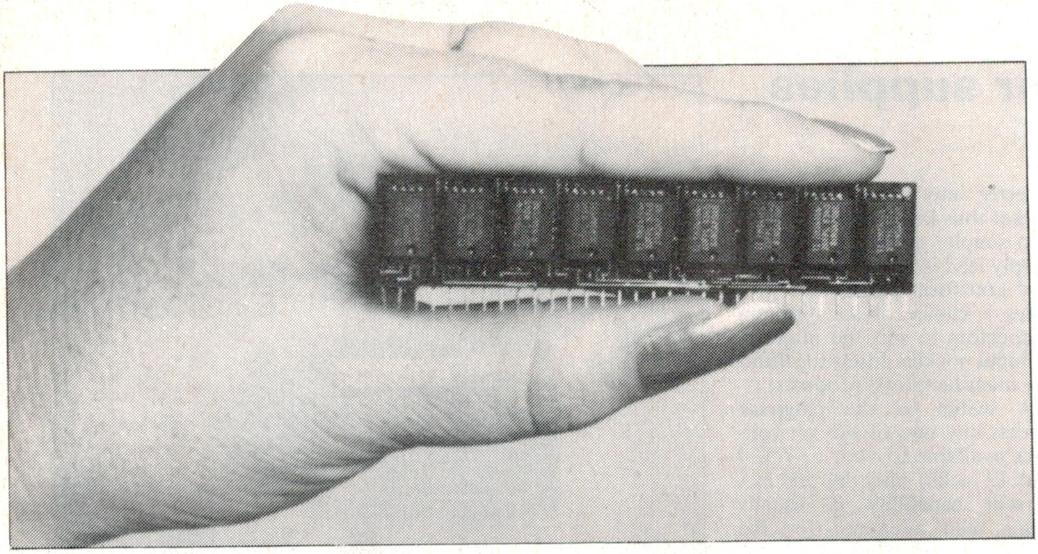
Positive sequencing between poles can be provided, if required. Silver contacts are standard. Gold-plated contacts suitable for low-voltage applications may also be specified if required.

The switch has been designed to accept a range of actuators.

A matching single-pole version will follow in the near future providing optimum versatility for multi-pole switching.

Available from Australian distributor **Bellco Controls/Email Ltd Relays Division.**





High density dynamic RAM family

TEXAS INSTRUMENTS has released a new family of low cost, high density, dynamic random access memory (DRAM) modules. The modules are organised in a single-in-line package (SIP) and use plastic leaded chip carriers.

The new TM416EC4 organised 64K x 4 can provide up to 3.5 times as much memory in the same board area as conventional dual-in-line package (DIP) DRAMs.

Other members of the new family, the TM4164EL8 (64K x 8 SIP), and the TM4164EL9 (64K x 9 SIP) allow even further reductions in board area. SIPs can also reduce system costs through improved reliability and they provide an easy upgrade path for next generation memory modules.

Principal uses for the 64K x 4/64K x 8 products include mainframe and super minicomputers memory modules, personal computers and other applications where the physical size of the equipment is dependent on memory system size.

With the SIP approach to memory system design, claims the company, several benefits are provided for the product designer. The number of plated through-holes can be reduced, lowering board cost and decreasing the number of board layers. Each 64K x 8 block of memory can reduce 128 plated through-holes to 30, and using on-SIP capacitors eliminates the need for bypass capacitors on the motherboard and gives superior performance over equivalent leaded capacitors due to diminished lead inductance. This improvement, combined with shortened pc trace lengths and reduced capacitance, lowers system noise and increases speed potential.

The TM4164EC4, TM4164EL8 and TM4164EL9 are the first members of a family of compatible SIP modules built using Texas Instruments DRAMs in plastic leaded chip carriers.

Each of the three SIPs is available in three versions: 120, 150 and 200 nanosecond maximum access times. They operate from a single 5 volt power supply in a 0-70°C free-air temperature range.

For additional information contact **Texas Instruments Semiconductor Division, (02)887-1122.**

Phoneme Speech Synthesizer

THE SSI 263A is a versatile, high-quality, phoneme-based speech synthesizer circuit contained in a single monolithic CMOS integrated circuit. It is designed to produce an audio output of unlimited vocabulary, music and sound effects at an extremely low data input rate.

Speech is synthesized by combining phonemes, the building blocks of speech, in an appropriate sequence. The SSI 263A contains five 8-bit registers that allow software control of speech rate, pitch, pitch movement rate, amplitude, articulation rate, vocal tract filter response, and phoneme selection.

To produce different speech phonemes (sounds) the SSI 263A uses a model of the human vocal tract. Within the device this analogue tract is modelled with five cascaded programmable low pass filter sections. The filter sections are programmed internally by a digital controller. Either a glottal (pitch) or a pseudo-random noise source is used to excite the vocal tract, depending on whether a voiced or non-voiced phoneme is selected. During speech production the phonemes will typically last between 25 and 100 ms.

The SSI 263A has two general classes of attribute data: 'control' data (speech rate, filter frequency, phoneme articulation rate, phoneme duration, immediate inflection setting, and inflection movement rate) and 'target' data (phoneme selection, audio amplitude, and transitioned inflection). The SSI 263A responds immediately upon loading 'control' data; upon loading 'target' data the device will begin to move towards that target at the prescribed transition rates. This fully internal linear transitioning between target values, done in a manner as is found in normal speech, is a key factor in reducing control data rate.

The synthesizer features a single low-power CMOS integrated circuit, a 5 volt supply, extremely low data rate, 8-bit bus compatible with selectable handshaking modes, non-dedicated speech, for text-to-speech programming, programmable and hard powerdown/reset mode, and switched-capacitor-filter technology.

For further information contact **R & D Electronics Pty Ltd, PO Box 57, Crows Nest, NSW 2065. (02)439-5488.**

Solid aluminium capacitors

THE NEW Philips 124-series of solid aluminium capacitors has a test life of 5000 hours at 85°C.

These single-ended capacitors are potted in a square epoxy resin case with tightly controlled dimensions. This means that the capacitors sit flush on a printed circuit board surface, enabling them to withstand severe shock and vibration. They are intended to replace tantalum capacitors in applications where high reliability is required.

The 124-series is for filtering, smoothing, coupling and decoupling in general and industrial applications — especially in automotive and mobile equipment.

Capacitance range is 0.1 to 68 μF, with a tolerance on nominal capacitance of ±20% (or ±10% on request).

For further information contact **Philips Electronics Components and Materials, PO Box 50, Lane Cove, NSW.(02)427 0888.**

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Best regards,

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Rod Irving

CRYSTALS

Cat No.	Freq.	Can	1-99	100+
Y11000	1MHz	HC33	5.50	4.75
Y11005	2MHz	HC33	2.25	1.95
Y11008	2.4576MHz	HC33	2.25	1.95
Y11015	3.57954MHz	HC18	1.20	.90
Y11020	4.00MHz	HC18	1.30	1.20
Y11022	4.194304MHz	HC18	1.40	1.30
Y11025	4.75MHz	HC18	1.40	1.30
Y11026	4.9152MHz	HC18	1.40	1.30
Y11042	6.144MHz	HC18	1.40	1.30
Y11050	8.00MHz	HC18	1.40	1.30
Y11055	8.867238MHz	HC18	1.40	1.30
Y11070	12.00MHz	HC18	1.40	1.30
Y11072	14.318MHz	HC18	1.40	1.30
Y11080	16.00MHz	HC18	1.40	1.30
Y11085	18.432MHz	HC18	1.40	1.30
Y11090	20.00MHz	HC18	1.40	1.30

POLYESTER 100V "GREENCAP" TYPE

Cat No.			1-99	100+
R15131	.001uF	100V	0.06	0.04
R15137	.0012uF		0.06	0.04
R15138	.0015uF		0.06	0.04
R15140	.0022uF		0.06	0.04
R15142	.0033uF		0.06	0.04
R15143	.0039uF		0.06	0.04
R15145	.0047uF		0.06	0.04
R15146	.0056uF		0.06	0.04
R15147	.0082uF		0.06	0.04
R15148	.01uF		0.07	0.05
R15150	.015uF		0.07	0.05
R15152	.022uF		0.07	0.05
R15154	.033uF		0.07	0.05
R15155	.039uF		0.07	0.05
R15156	.047uF		0.08	0.06
R15157	.056uF		0.08	0.06
R15158	.068uF		0.08	0.06
R15159	.082uF		0.08	0.07
R15160	.1uF		0.09	0.08
R15162	.15uF		0.11	0.10
R15164	.22uF		0.13	0.11
R15165	.27uF		0.14	0.13
R15172	1uF		0.60	0.48
R15176	2.2uF	1.10	0.90	
R15178	3.3uF	1.50	1.20	

DIODES

Cat No.	Desc	1-99	100-999	1000+
Z10135	IN4148	0.03	0.02	0.015
Z10105	IN4002	0.04	0.03	0.03
Z10107	IN4004	0.05	0.04	0.02
Z10110	IN4007	0.10	0.06	0.05
Z10115	IN5404	0.18	0.14	0.11
Z10119	IN5408	0.20	0.16	0.13

TRANSISTOR

	1-99	100+
2SJ49	3.50	3.30
2SK134	3.50	3.30

MULTIMETERS

	1-99	100+
YF1100	42.50	40.00

ELECTROLYTICS

Cat No.	Desc.	1-99	100+
R1415	1uF 63V PCB RB	0.05	0.04
R15461	10uF 16V PCB RB	0.05	0.04
R15462	10uF 25V PCB RB	0.05	0.04
R15482	22uF 25V PCB RB	0.06	0.05
R15521	47uF 16V PCB RB	0.07	0.06
R15522	47uF 25V PCB RB	0.08	0.07
R15581	1000uF 16V PCB RB	0.21	0.20
R15582	1000uF 25V PCB RB	0.28	0.25
R15591	2200uF 16V PCB RB	0.39	0.33
R15592	2200uF 25V PCB RB	0.55	0.50
R15904	2200uF 50V AXIAL	1.50	1.00

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TAPED AND BOXED $4.75/1000
$4.75/1000 10K LOTS
1/4 METAL FILM TAPED AND BOXED
$12.00/1000 $10.00/1000/10K LOT

MEMORY

	10-99	100-999	1000+	10K+
4164-15P	$3.50	$2.95	$2.75	$2.50
41256	$19.00	$14.00	$13.00	$12.00
6116P-3	$6.00	5.90	$5.80	$5.50
2716	$4.90	$4.50	$4.25	$4.00
27128	$16.00	$15.00	$13.50	$13.00
2532	$7.50	$6.50	$6.40	$6.30

TRANSFORMERS

Cat No.		1-99	100+
M12851	2851	2.00	1.75
M12155	2155	4.00	3.50
M16672	6672	5.10	4.75

MONITORS

Cat No.			1-3	4+
X14500	Ritron 1	Green	$100.00	$95.00
X14502	Ritron 1	Amber	$105.00	$100.00
X14506	Ritron 2	Amber	$125.00	$122.00
X14510	Ritron 3	Amber	$129.00	$124.00

75OHM COAX CABLE

Cat No.		100M	500M	1000M
W11222	3C2V	18.00	17.00	16.00
W11224	5C2V	21.00	20.00	19.00

(5C2V WHITE)
100M ROLLS
LINE LOSS PER 100' (33M 200MHz)

W11222	6.2dB	(Approx)
W11224	3.9dB	(Approx)

COMPUTER CONNECTORS

Cat No.		1-99	100+
P10900	DB25 Plug	1.30	1.20
P10901	DB25 Socket	1.40	1.30
P12210	Centronics Solder	3.50	3.15
P12200	Centronics Crimp	4.00	3.75

NICADS

Cat No.		1-99	100+
S15021	C 1.8AH	3.25	2.90
S15022	D 4.0AH	5.90	5.50

HORN SPEAKERS

Cat No.		1-99	100+
C12010	5" Plastic 8W Max	4.80	4.70
C12015	5" Metal 8W Max	4.70	4.30

METAL BOXES

Cat No.	1-99	100+
H10442	2.50	2.00

SOLDERING IRON STANDS

Cat No.	1-99	100+
T11302	3.25	3.00

VERBATIM DATA LIFE DISKETTES

		1-99	100+	1000+
SS/DD	MD525-01	2.50	2.20	2.00
DS/DD	MD550-01	3.30	3.00	2.60

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		1-9	10+
240V	4½"	10.50	10.00
240V	3½"	10.50	10.00
115V	4½"	10.50	10.00
115V	3½"	10.50	10.00

RG CAN TYPE WITH LUGS

		1-99	100+
R164585	8000uF 75V	6.00	5.80
R16587	10,000uF	7.00	6.50

IDC CONNECTORS

		1-99	100+
P12114	14 Pin Dip Plug	0.60	0.50
P12116	16 Pin Dip Plug	0.65	0.55

GREY FLAT RIBBON CABLE

				PER 100' ROLL	
Cat No.	No Cond	Per Mtr	1-3	4+	10+
W12616	16 Way	1.29	19.75	18.50	16.50
W12625	25 Way	1.40	29.50	27.50	23.50
W12626	26 Way	1.60	31.00	29.00	25.00
W12634	34 Way	1.80	40.00	38.00	34.00
W12640	40 Way	2.20	50.00	47.50	42.50
W12650	50 Way	2.75	59.00	57.50	52.50

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PANEL METERS

		1-9	10+
Q10500	MU45 0-1mA	5.50	5.25
Q10502	MU45 50-0-50uA	5.50	5.25
Q10504	MU45 0-100uA	5.50	5.25
Q10505	MU45 0-50uA	5.50	5.25
Q10510	MU45 0-5A	5.50	5.25
Q10518	MU45 0-1A	5.50	5.25
Q10520	MU45 0-20V	5.50	5.25

BRIDGES

Cat No.	6A 400V	1.00	0.80	0.75

RCA INSULATING SOCKETS

Cat No.		1-99	100+
P10232	2 Way	0.25	0.21
P10234	4 Way	0.45	0.40
P10236	6 Way	0.75	0.60

RCA CHASSIS MOUNT METAL

CAT NO.	1-99	100+
P10231	0.16	0.13

MITSUBISHI DISK DRIVE

		1-9	10+
4851	5¼"	$180.00	$170.00
4853	5¼"	$220.00	$205.00
4854	5¼"	$280.00	$260.00
2896	8"	$450.00	$420.00

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Minimum wholesale purchase $25

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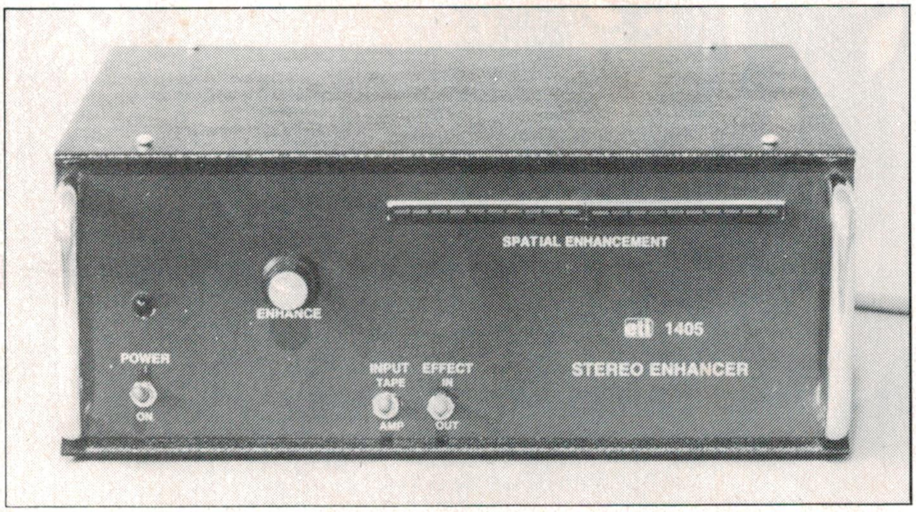
Project 1405

STEREO ENHANCER

The best thing about stereo is that it sounds good! The greatest stereo hi-fi system loses its magnificence if the effect is so narrow you can't hear it. This project lets you cheat on being cheated and creates an 'enhanced stereo effect' with a small unit which attaches to your amp.

Robert Irwin



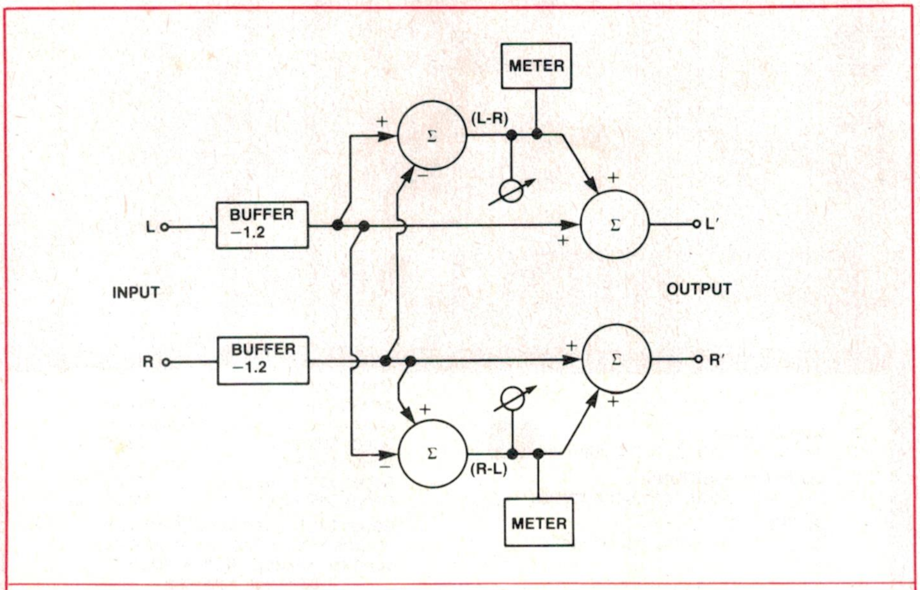


Figure 1. Block diagram of the enhancer circuit

WHEN IS A STEREO not a stereo? Answer: When you try to fit your 60 cubic foot, six way monitors into your new, one bedroom flatette and find that the only place you can put them is side by side where they double as a dining table. Not the ideal situation to get that wonderful stereo separation that causes steam trains to thunder in one side of your living room, roar across the coffee table and exit through the window on the opposite side.

The ETI-1405 is designed to 'widen' out the stereo image from your amp and allow you to maintain that stereo feel even when you have to put your speakers close together.

The unit is designed to plug into the cassette input and output on the back of a standard stereo amp and can be switched in and out of circuit by using the TAPE/SOURCE switch. An alternate set of cassette in/out terminals is provided on the back of the enhancer to plug your deck into.

Design details

The idea behind the circuit is very simple and has been used in small portable stereo tape decks for quite a while. Figure 1 shows a block diagram of the circuit of the enhancer. The principle used is basically to obtain the difference between the left and right channel and then to subtract this from the original left and right channel signals. This is explained more fully in the "How it Works" section.

The end result is to obtain a 'super stereo' signal which has components for the left channel of $L+A(L-R)$ and for the right channel of $R+A(R-L)$ where R is the original right channel signal, L is the original left channel signal and A is a proportion between 0 and 1 which is set by the level control.

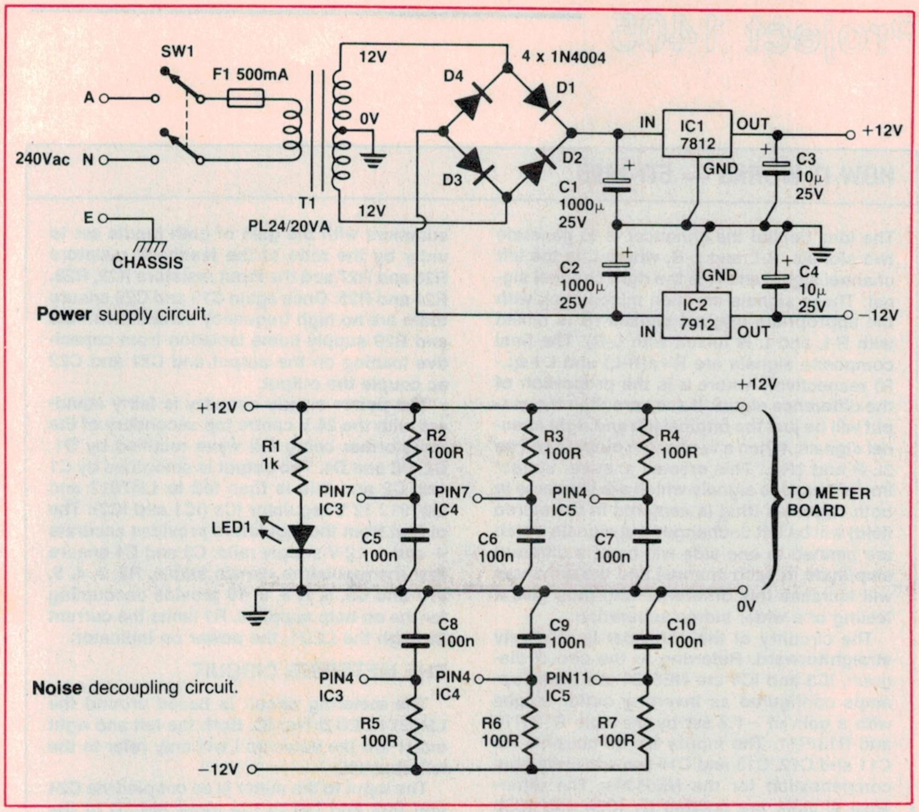
One unusual feature of the design came about in the metering provided. It was firstly thought that a measure of the signal levels at the output, along the lines of VU metering, should be provided.

After a quick rethink though, it was decided that this wouldn't really be of much

benefit to anyone as the signal levels here weren't really interesting. A much more relevant meter would be one that in some way indicated the amount of enhancement taking place. LED level meters were, therefore, placed at the output of the level control pot in the difference amp section of each channel. This gave a direct and dynamic representation of the enhancement. To add to this, the displays for each channel were mounted back to back giving a centre-zero, bar graph display which visually shows the widening of the stereo image.

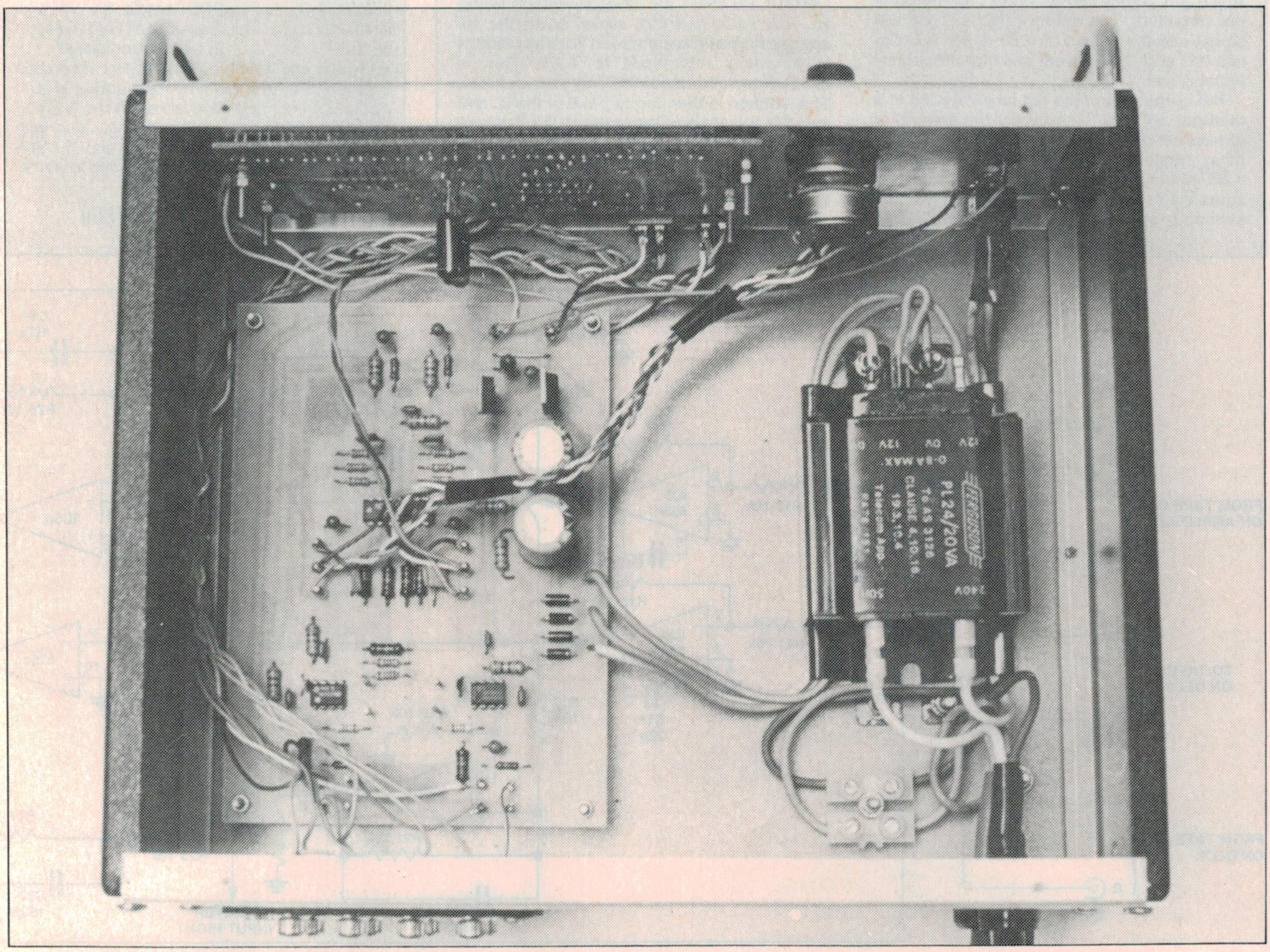
Construction

It is best to begin construction with the case. The prototype was mounted in a Horwood instrument case. If you are using an



Power supply circuit.

Noise decoupling circuit.



HOW IT WORKS — ETI-1405

The idea behind the enhancer is to generate two signals, R-L and L-R, where L is the left channel signal and R is the right channel signal. These signals are then mixed back with the appropriate original signals (R is mixed with R-L and L is mixed with L-R). The final composite signals are R+a(R-L) and L+a(L-R) respectively where a is the proportion of the difference signal. If a is zero then the output will be just the original left and right channel signals. When a is one, the outputs will be 2L-R and 2R-L. This creates a 'super stereo' image because signals which are the same in both channels (that is centered in the stereo field) will be left unchanged but signals which are panned to one side will be of a different amplitude in each channel and the enhancer will increase this difference and thus give a feeling of a wider stereo separation.

The circuitry of the enhancer is relatively straightforward. Referring to the circuit diagram, IC3 and IC4 are NE5534 low noise op-amps configured as inverting buffer stages with a gain of −1.2 set by the ratio R12/R10 and R13/R11. The inputs are ac coupled via C11 and C12. C13 and C14 provide unity gain compensation for the NE5534s. The difference signals are created by IC5a and IC5b which are configured as unity gain differential amplifiers. The output of IC5a is the L-R signal and the output of IC5b is the R-L signal. C15 and C16 prevent any high frequency instabilities.

The outputs from the diff amps are fed to a dual pot, RV1, which controls the amount of difference signal being fed to the final summing amplifier stages formed by IC5c and IC5d and associated resistors. This stage sums the original and difference signals. The summing amps are virtual earth, inverting summers with the gain of both inputs set to unity by the ratio of the feedback resistors R26 and R27 and the input resistors R22, R23, R24 and R25. Once again C19 and C20 ensure there are no high frequency instabilities. R28 and R29 supply some isolation from capacitive loading on the output and C21 and C22 ac couple the output.

The power supply circuitry is fairly standard with the 24 V centre tap secondary of the transformer being full wave rectified by D1, D2, D3 and D4. The output is smoothed by C1 and C2 and this is then fed to LM7812 and LM7912 12 V regulator ICs (IC1 and IC2). The output from the regulators provides accurate + and − 12 V supply rails. C3 and C4 ensure that the regulators remain stable. R2, 3, 4, 5, 6, 7 and C5, 6, 7, 8, 9, 10 provide decoupling for the op-amp supplies. R1 limits the current through the LED1, the power on indicator.

THE METERING CIRCUIT

The metering circuit is based around the LM3914 LED driver IC. Both the left and right meter are the same so I will only refer to the left channel.

The input to the meter is ac coupled via C24 and R32 and fed to the input pin (5) of the LM3914. D5 limits the reverse voltage swing to −0.6 volts and C26 slows down the response time of the meter. Pin 7 of the LM3914 is internally referenced to 1.2 V. This is divided down to about 0.2 V by R36 and R34. This voltage is then fed to pin 6 of the IC and sets the full scale of the meter to 0.2 V. If less sensitivity is required then R34 can be increased. The sum of R34 and R36 should be kept to less than about 1 K otherwise the brightness of the display may decrease.

PARTS LIST — ETI-1405

Resistors ....all ¼ W, 5%
R1 .... 1k
R2, 3, 4, 5, 6, 7, 28, 29, 34, 35 .... 100R
R8, 9, 30, 31, 32, 33 .... 100k
R10, 11, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27 .... 10k
R12, 13 .... 12k
R36,37 .... 560R
RV1 .... 100k lin. dual ganged

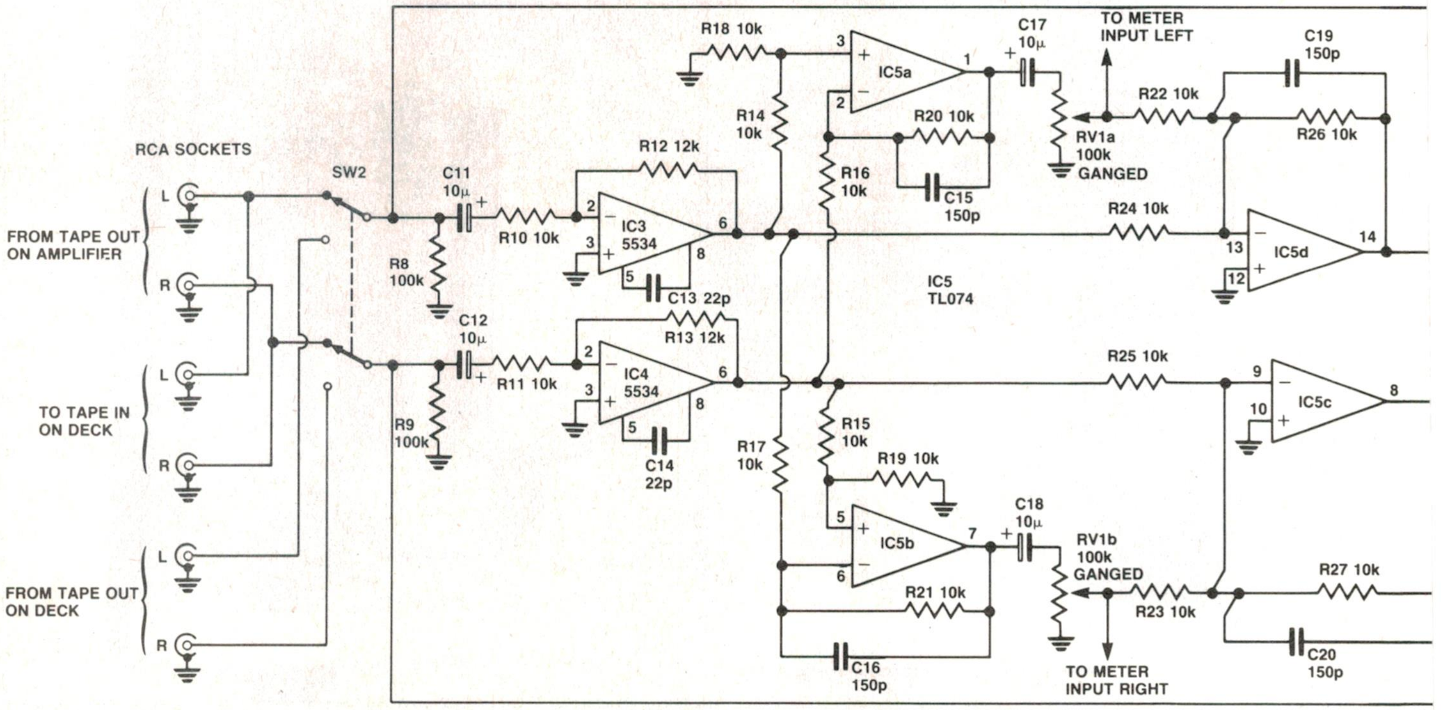
Capacitors
C1, 2 .... 1000µ 25 V RB electro.
C3, 4, 11, 12, 17, 18, 21, 22, 24, 25 .... 10µ 25 V electro.
C5, 6, 7, 8, 9, 10 .... 100n ceramic bypass
C13, 14 .... 22p ceramic
C15, 16, 19, 20 ...... 150p ceramic
C23, 28 .... 2µ2 25 V RB electro.
C26, 27 .... 220n greencap

Semiconductors
IC1 .... LM7812 pos. regulator
IC2 .... LM7912 neg. regulator
IC3, IC4 .... NE5534 op-amp
IC5 .... TL074 quad op-amp
IC6, IC7 .... LM3914 LED driver
D1, 2, 3, 4 .... 1N4004 rectifier diodes
D5, 6 .... 1N914 small signal diode
LED1 .... 5mm red LED
two 10 LED arrays

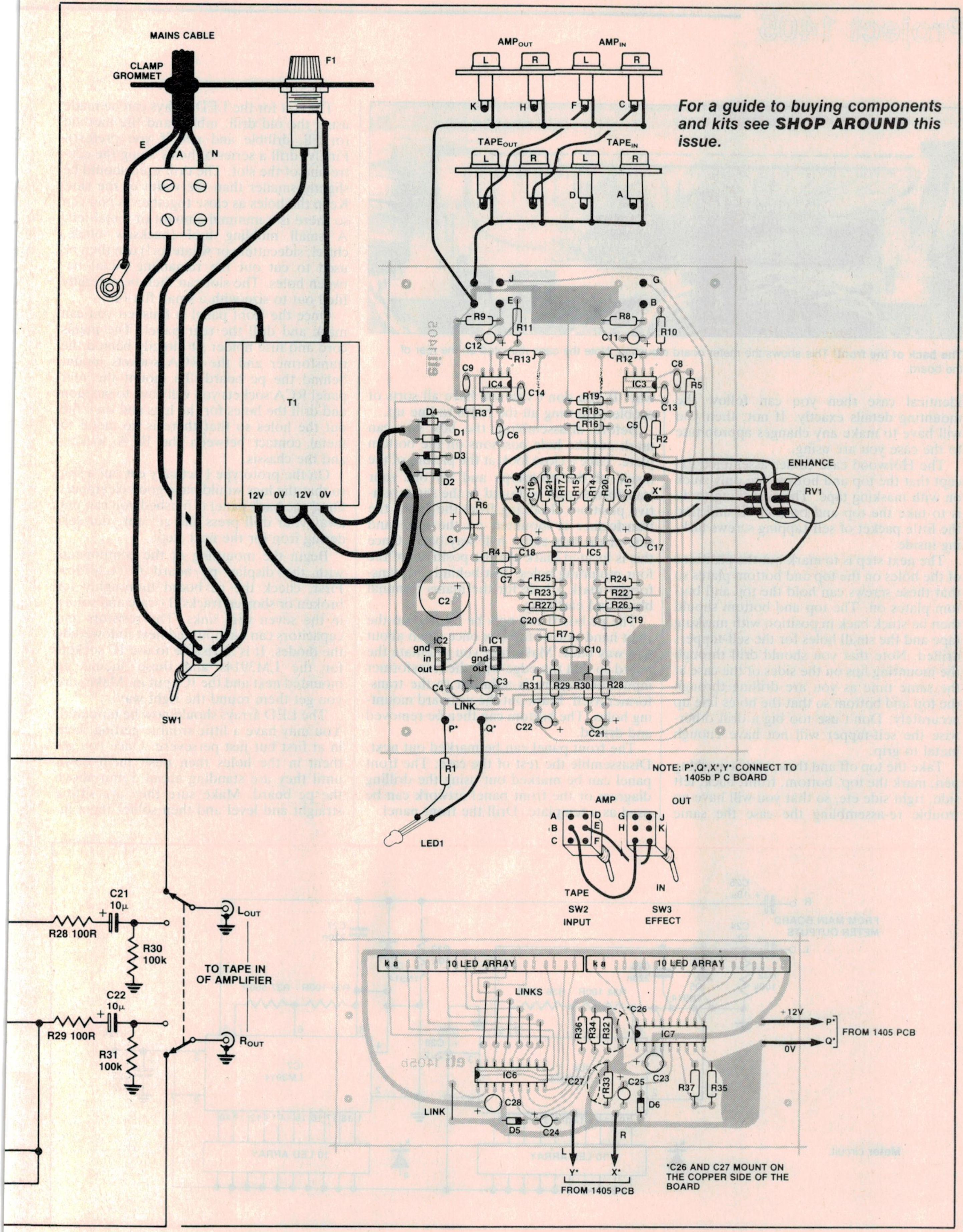
Miscellaneous
SW1, 2, 3 .... DPDT toggle
T1 .... Transformer Ferg. type PL24/20VA or similar

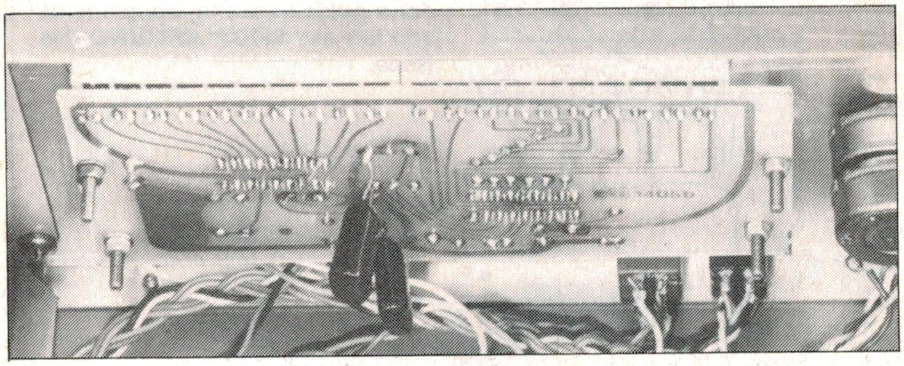
ETI-1405 and 1405b pc boards; Horwood case type 84/10/V; two four way RCA socket arrays; Scotchcal front and back labels; mains flex and plug; mains grommet and clamp; four way terminal block; 2AG fuse holder and 500 mA fuse; hookup wire; nuts and bolts; knob for rotary pot; four rubber feet.

Price estimate: $70-$80



For a guide to buying components and kits see SHOP AROUND this issue.





The back of the front! This shows the meter board mounting. Note the caps mounted on the rear of the board.

identical case then you can follow the mounting details exactly. If not, then you will have to make any changes appropriate to the case you are using.

The Horwood case comes assembled except that the top and bottom are only stuck on with masking tape. The first thing to do is to take the top and bottom off and find the little packet of self-tapping screws lurking inside.

The next step is to mark out the positions of the holes on the top and bottom plates so that these screws can hold the top and bottom plates on. The top and bottom should then be stuck back in position with masking tape and the small holes for the self-tappers drilled. Note that you should drill through the mounting lips on the sides of the case at the same time as you are drilling through the top and bottom so that the holes line up accurately. Don't use too big a drill otherwise the self-tapper will not have enough metal to grip.

Take the top off and then, with a marking pen, mark the top, bottom, front, back, left side, right side etc, so that you will have no trouble re-assembling the case the same way. If you don't you will have all sorts of problems getting all the holes to line up.

Before disassembling the box you can mark out the hole positions on the bottom plate. Take a close look at the picture of the inside of the prototype and lay out your transformer and pc board in the same relative positions. Looking from the front, the transformer is mounted on the left hand side of the box about half way back. Once this is located mark out the positions of the four mounting holes. Just behind the transformer mark a hole for the mains terminal block and earth lug.

The pc board can now be located on the right hand side of the box once again about half way back. Make sure you orientate the board so that the edge with the transformer input connections is adjacent to the transformer itself. Mark out the pc board mounting holes. The bottom can then be removed and drilled.

The front panel can be marked out next. Disassemble the rest of the case. The front panel can be marked out using the drilling diagram or the front panel artwork can be used as a template. Drill the front panel.

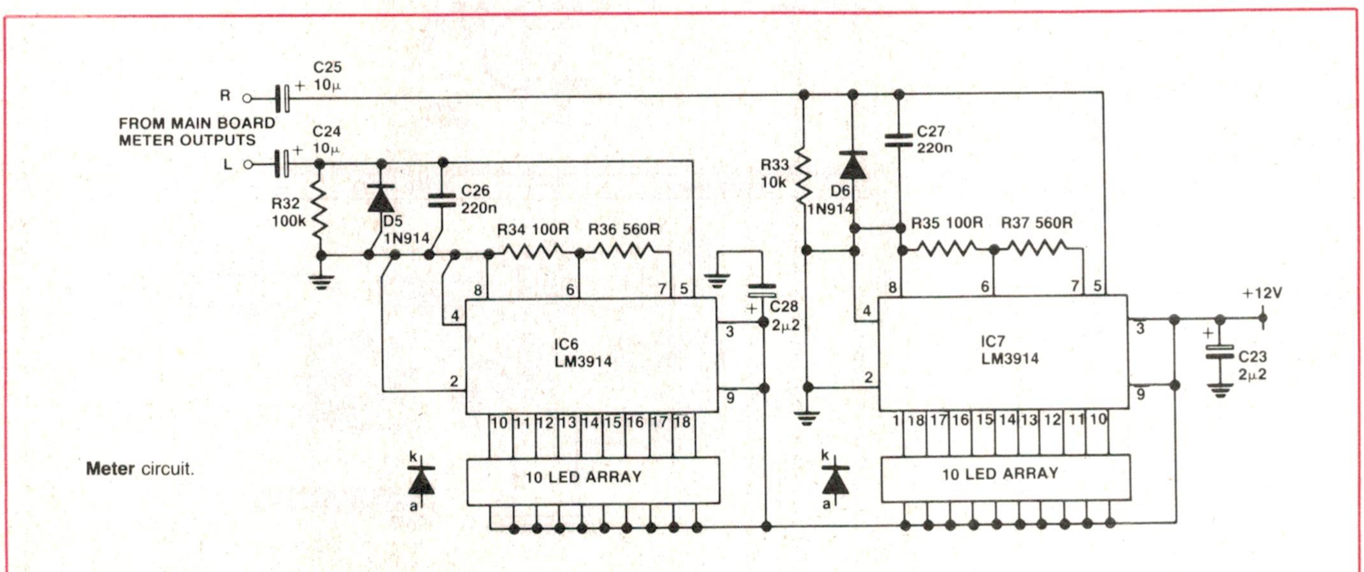
The slot for the LED arrays can be made using the old drill, nibble and file method (or fill, dribble and nile if you prefer!). Firstly, drill a series of holes along the centre line of the slot. The drill used should be slightly smaller than the width of the slot. Keep the holes as close together as you can so there is a minimal amount of metal left. A small nibbling tool (hacksaw blade, chisel, sidecutters or whatever!) can then be used to cut out the remaining metal between holes. The slot can then be carefully filed out to size with a small flat file.

Once the front panel is finished you can mark and drill the rear panel. The mains cord and fuse holder sit directly behind the transformer and the RCA sockets mount behind the pc board. To mount the rear panel RCA sockets you will have to position and drill the holes for the lugs and then file out the holes so that there is no metal to metal contact between the RCA sockets and the chassis.

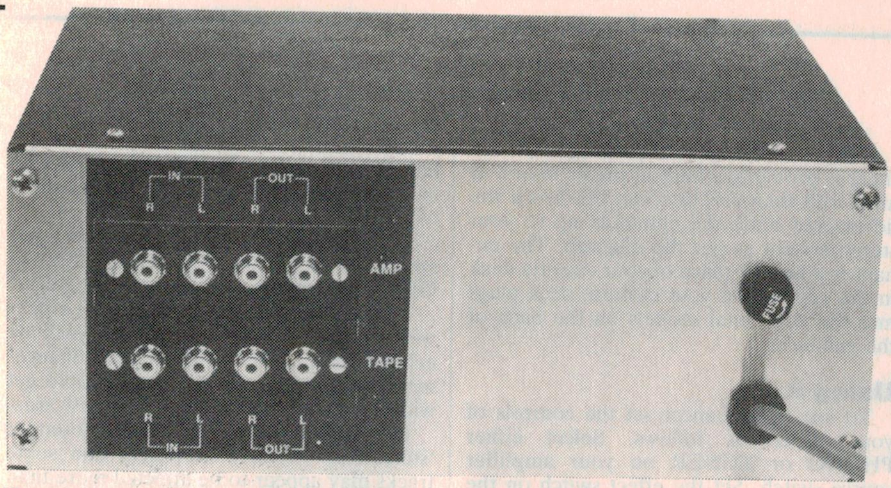
On the prototype I actually cut out a slot so that the lugs would have good clearance. Once the back panel is finished you can put away your drill press and get out your soldering iron for the next step.

Begin the mounting of the components with the display pc board (ETI-1405b). First, check the pc board thoroughly for broken or shorted tracks. Locate and solder in the seven wire links. The resistors and capacitors can be mounted next followed by the diodes. It is advisable to use IC sockets for the LM3914s and these should be mounted next and the ICs put in. Make sure you get them round the right way.

The LED arrays should now be mounted. You may have a little trouble getting them in at first but just persevere. Once you get them in the holes then push them down until they are standing about 5 mm above the pc board. Make sure they are sitting straight and level and then solder them in.



Meter circuit.



View of the rear panel showing the two RCA arrays.

Take care that you get the displays the right way round as desoldering them can be a real pain in the enhancer.

The two capacitors which mount on the copper side of the board can now be soldered on. The only thing left to be done on this board is to solder about 100 mm lengths of hookup wire to the input and power supply pads.

Turn your attention now to the main pc board. This should be constructed in a similar way to the display board. Resistors and caps first followed by diodes and ICs. Once again take care to get all the polarized components the right way round, especially the big electrolytic caps on the power supply.

Do not use IC sockets with the ICs on this board as the stray resistances and capacitances can degrade the performance of the circuit. Solder pegs should be used on all the flying lead connections on this board to make the wiring up easier.

The next step in construction is to attach the Scotchcal artwork to the front panel. Firstly drill small pilot holes in the centres of all the holes and at the end points of the slot on the Scotchcal. Peel off the backing paper on the Scotchcal and thoroughly wet the back of the Scotchcal and the front panel (the water will allow you to easily peel off the label again if you don't line it up correctly the first time).

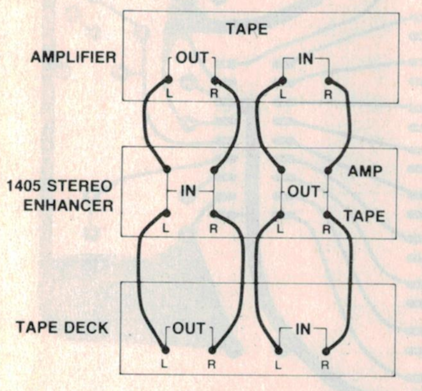


Figure 2. Connecting the stereo enhancer to your amp and tape deck.

Line up the holes on the Scotchcal with the holes drilled in the front panel and then press the Scotchcal firmly in place. Gently rub out the excess water with a soft cloth and set the front panel aside to thoroughly dry. The same treatment can be given to the Scotchcal back panel.

When both the panels are completely dry the holes can be carefully cut out and trimmed using a very sharp knife or scalpel. Try not to tear the Scotchcal or cut off a finger when doing this.

Before re-assembling the case you should attach the mounting bolts for the display board. Sit the display board on the back of the front panel so that the LED displays fit through their slot. Mark out the positions of the mounting holes. Four 20 mm long 6BA flat headed bolts should then be glued to the back of the front panel with Araldite or something similar. Allow the glue to completely harden. The case should now be re-assembled with the exception of the lid.

Now comes the wiring up. Start with the mains wiring. Firstly, securely mount the transformer, terminal block and fuse holder. Mount a length of mains flex using either a clamp type mains grommet or a grommet and separate mains clamp.

Carefully follow the wiring diagram and wire up the mains switch, fuse holder and primary of the transformer with heavy duty hookup wire. Make sure that you insulate any exposed joins or terminals with heat-shrink or insulating tape. REMEMBER: mains voltages are lethal so double and triple check your wiring and make sure that you can't accidentally touch any exposed terminals. The mains switch can now be securely mounted to the front panel.

Next mount the display board. The board should be mounted so that the LED arrays protrude about 2 mm through the front panel. The main board can be mounted next using 12 mm spacers.

Using the wiring diagram, wire the secondary of the transformer to the main board. The flying leads from the display board can also be attached to the main board at the appropriate points. The power indicator LED can then be mounted and wired up. The two RCA socket arrays should then be mounted on the rear panel. The input and output wiring, including the ▶

two switches, can then be done.

Finally, 250 mm lengths of hookup wire can be attached to the dual 'enhancement' pot and then attached to the pc board. The pot can then be mounted on the front panel and the knob attached.

Testing and setting up

The only real way of testing the enhancer is to turn it on so, with nothing attached to the input or output, plug it into the mains and switch on for a few seconds. The power LED should light and all the display LEDs should remain off. Other than that nothing should happen. If anything else happens (smoke, fire, brimstone, nasty hissing or popping noises, etc) switch off immediately and check everything.

If all is OK then switch on again and try rotating the enhancement pot. The display LEDs should stay off. If any come on then there is probably a fault in the pc board. If all is well then you turn can off, screw the lid on and hook the enhancer up to your stereo system as per the diagram. The enhancer takes the place of your cassette deck in the system and your cassette deck plugs into the additional sockets on the back of the enhancer.

Using it

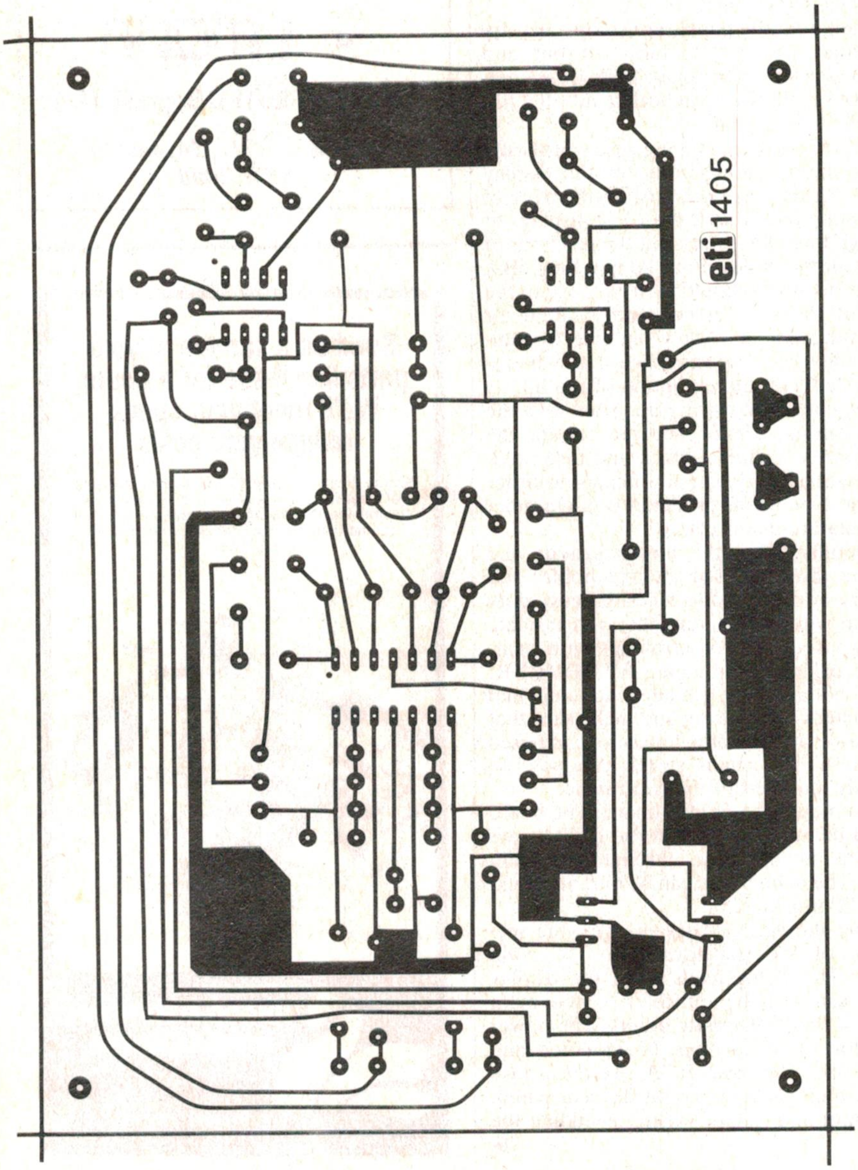
To use the enhancer set the controls of your stereo as follows. Select either PHONO or TUNER on your amplifier source switch. Set the effect switch on the enhancer to IN and the input switch to AMP.

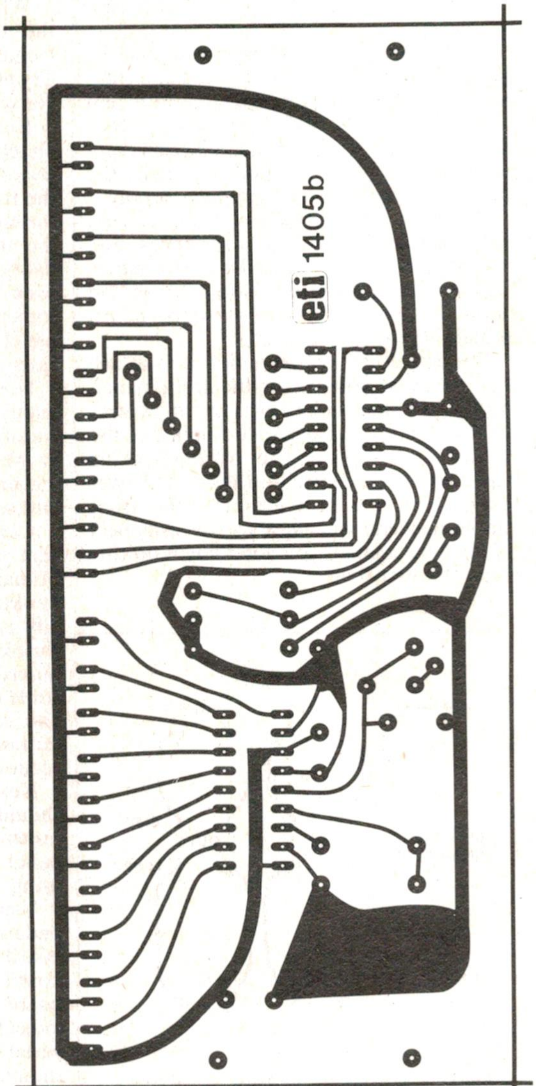
Now all you need do is select TAPE on the TAPE/SOURCE button on your amp to cut the effect in. With the TAPE/SOURCE button on SOURCE the effect will be bypassed. To play a cassette through the enhancer once again select TAPE on the amp and switch the input switch on the enhancer to TAPE.

To play a cassette without the effect just switch the effect switch on the enhancer to OUT. Don't worry, you'll get the hang of it!

Turning the enhancement control clockwise increases the effect and this will be echoed in the LED display. As the enhancement is increased the bargraph should get wider and wider from the centre outwards.

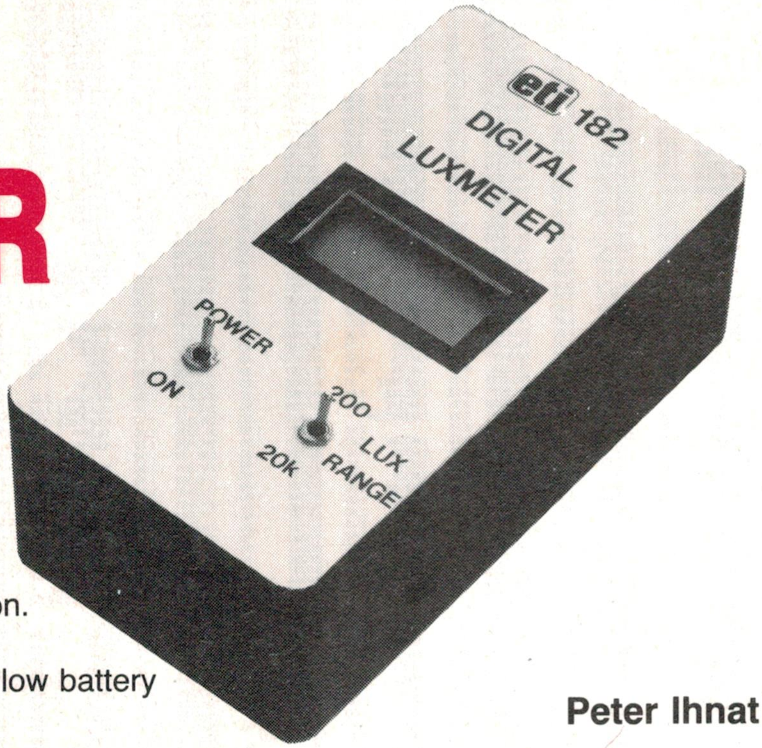
It should be noted that the amount of 'stereoness' is fairly subjective and some tracks may appear to be affected more than others. At first the effect may sound a little false but it is a bit like 3D pictures in that you must let your brain deceive your senses. When you get over trying to convince yourself that your speakers aren't far enough apart to get good stereo then the effect will be more convincing. ●





Project 182

DIGITAL LUXMETER



This instrument is a portable, battery operated device for measuring illumination. It covers light levels from below 1 lux up to 20k lux in two ranges and includes low battery indication.

Peter Ihnat

ETI, IN THE PAST, has described many instruments for measuring just about anything from heart rate through to passion (yes, we published a passion meter once long ago !!!). One quantity however which seems to have missed out is *light*.

In the last twelve months we described two devices which measure light, but not in absolute terms. They were both darkroom exposure (or light) meters. These 'measure' the amount of light in a particular area of the image produced by an enlarger by comparing the intensity with that of a value obtained when a test print was made. Unfortunately, outside the darkroom this technique is of limited use.

The current project can measure light in absolute terms, just as we measure current in amps and frequency in Hertz. This results in a versatile unit for anyone having anything to do with lighting systems. Some examples include, photographers, electricians who fit lights into classrooms, offices and factories or even the home video nut who insists on video taping under very low light levels . . . the list is endless.

Why do these people need to know the level of illumination? The answer is rather obvious in the case of photographers, movie and video camera operators. They need to ensure that the illumination of a scene or subject is sufficient to produce images with the maximum amount of detail. Poor lighting setups can only produce poor images.

In the case of classroom, factory and office lighting, there are recommended illumination levels to suit the type of work performed in each area. To give the reader an idea of illumination available from some common sources and some recommended levels, refer to Table 1. As you may notice, the eye (like the ear) has a wide dynamic range.

One problem in the past with designing a luxmeter was that a suitable sensor was not available in this country. Only fairly recently has one of the few photodiodes which covers more than the red and infra-red regions of the spectrum become readily available in Australia. Ladies and gentlemen . . . introducing the BPW21 photodiode.

Figure 1 shows some of the photodiode's characteristics. Its peak spectral response is around 555 nm, corresponding to yellow/green light. Its spectral range is 350 to 775 nm which almost matches that of the human eye (see dotted line labelled as Vλ). For many applications this is quite adequate and makes it ideal for monitoring daylight or artificial light. One more important feature is that its short circuit current versus illumination is highly linear over a wide range (0.01 to 100k Lux) . . . truly a remarkable sensor.

Description	illumination
Full moon	0.4
Candle flame at 1 m	1
Highways	20-30
Living rooms and offices	300-400
Shops, workshops and classrooms	500
Area for fitting components to pc board	800
Precision engineering workshops, drawing offices	1000
High precision work eg, repairing watches	3000
Bright summer day	100 000

Table 1. Illumination levels in lux.

Figure 2 shows the operation of the luxmeter in block diagram form. The BPW21 is connected in the standard way (reverse biased and into a short circuit) to produce a current in direct proportion to illumination. This is converted to a voltage which is fed into a voltmeter and displayed in digital form. Normally, a circuit such as this would be rather complex but the availability of the ICL7106 digital voltmeter IC reduces the parts count dramatically. Those interested in the digital voltmeter circuitry can refer to two previous ETI articles — ICL7106 data sheet ETI October 1977 and project 161 ETI August 1982.

Contruction

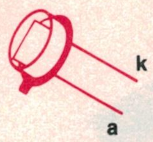
Construction should present few problems if the recommended pc board is used. The layout is not critical and other forms of construction such as Vero-board, may be employed. Use of the recommended board does result in a very compact unit and if correctly assembled will help to ensure that everything works first go.

Firstly, inspect the pc board for broken tracks or shorts — check carefully in the areas where tracks pass between IC pins. If all is OK, start by fitting the three wire links. Note that one link has a 90° bend in it.

Next, mount the resistors, capacitors and trimpots in that order — it may be necessary to bend the leads of capacitor C6 inwards slightly to fit in its correct position. The 40- ▶

Silicon photodiode with incorporated Vλ filter

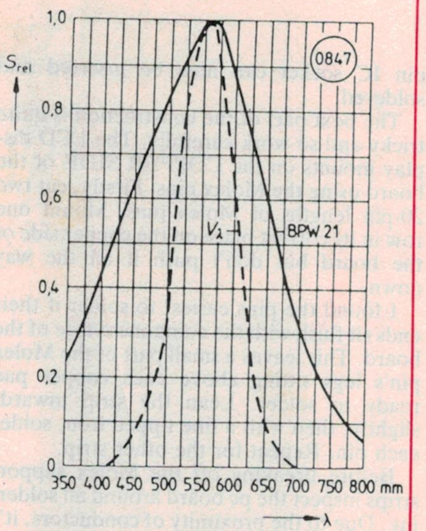
BPW21



Special features:

- High reliability
- No testable degradation
- Low noise
- High open-circuit voltage as photovoltaic cells
- Detector for low illuminance
- Short switching time
- High photosensitivity
- Strong logarithmic relation between V_0 or I_S and illuminance of 10^{-2} to 10^5 lx
- Wide temperature range
- Suitable in the range of visible light

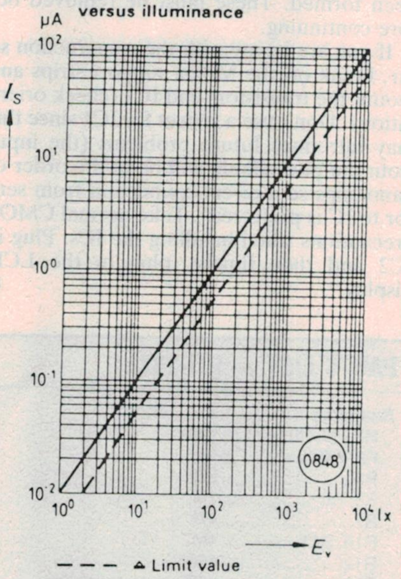
Relative spectral photosensitivity versus wavelength



Characteristics (T_{amb} = 25°C)

Photosensitivity (V_R = 5 V, standard light A, T = 2856 K)	S	9 (≧ 5,5)	nA/lx
Wavelength of max. photosensitivity	$\lambda_{S\ max}$	550	nm
Spectral range of photosensitivity (S = 10% of S_{max})	λ	350...775	nm
Radiant sensitive area	A	7.34	mm²
Dimension of radiant sensitive area	L x B	2.71 x 2.71	mm
Distance chip surface to case top edge	H	1.9...2.3	mm
Half angle	φ	60	degrees
Dark current (V_R = 5 V)	I_R	2 (≦ 30)	nA
(V_R = 10 mV)	I_R	8	pA
Spectral photosensitivity (λ = 550 nm)	S_λ	0.21	A/W
Quantum yield (λ = 550 nm)	η	0.47	Electrons / Photon
Open-circuit voltage (E_v = 1000 lx, standard light A, T = 2856 K)	V_0	390 (≧ 320)	mV
Short-circuit current (E_v = 1000 lx, standard light A, T = 2856 K) (Deviation of I_s linearity in the range of $3 \cdot 10^{-2}$ to 10^4 lx: max. 12%)	I_S	9 (≧ 5,5)	µA
Rise and fall time of photocurrent from 10% to 90% and from 90% to 10% of final value (R_L = 1 kΩ, V_R = 10 V, λ = 550 nm, I_P = 9 µA)	t_r, t_f	1	µs
Forward voltage (I_F = 100 mA, E_e = 0, T_{amb} = 25°C)	V_F	1.2	V
Capacitance (V_R = 0 V, f = 1 MHz, E_v = 0 lx)	C_0	750	pF
(V_R = 10 V, f = 1 MHz, E_v = 0 lx)	C_{10}	220	pF
Temperature coefficient of V_0	TC	−2.6	mV/K
Temperature coefficient of I_S	TC	0.12	%/K

Short-circuit current versus illuminance



Directional characteristic
Short-circuit current versus half angle

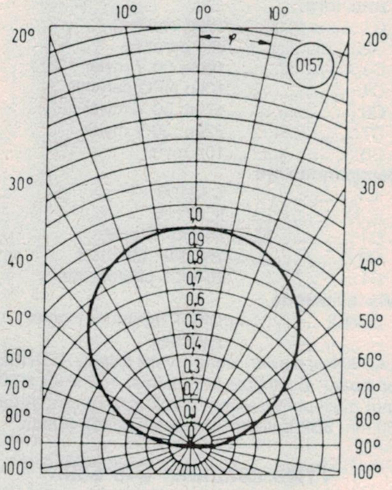


Figure 1. Silicon photodiode characteristics.

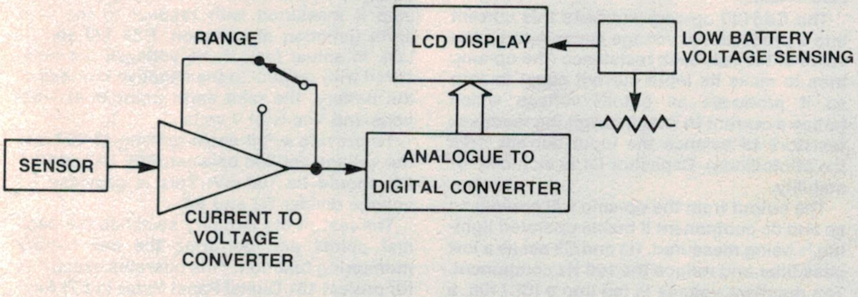


Figure 2. Block diagram.

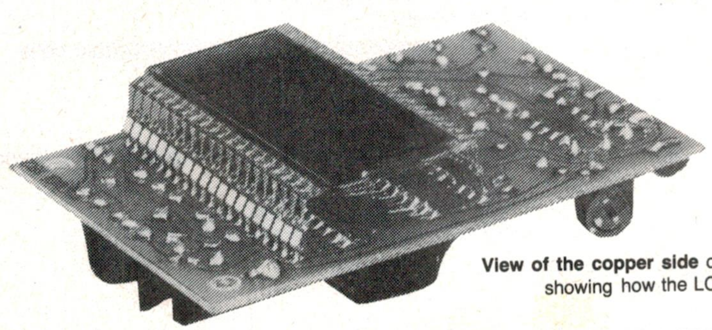
pin IC socket can now be inserted and soldered.

The next part of the construction is quite tricky and so work carefully. The LCD display mounts on the COPPER SIDE of the board using the Molex pins. Firstly, cut two 20-pin lengths of Molex pins. Mount one row in its correct place on the copper side of the board but don't push it all the way down.

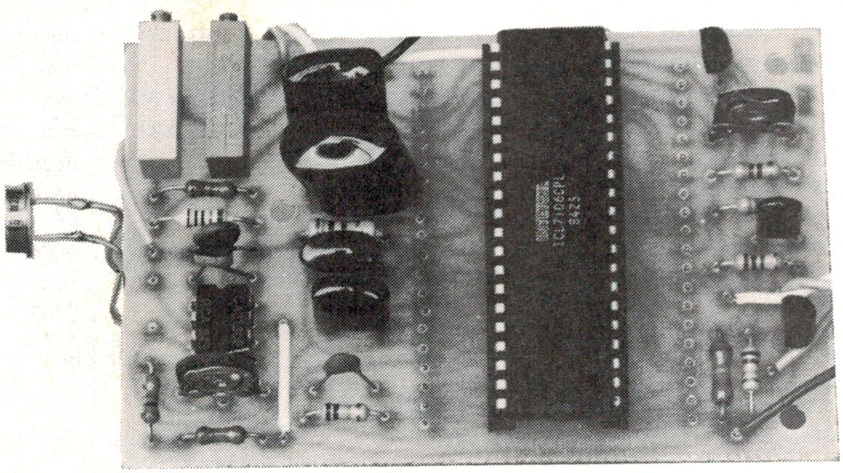
I found the pins easiest to solder if their ends sit flush with the component side of the board. This leaves a small part of the Molex pin's legs sitting above each copper pad ready to solder. Lean the strip inwards slightly, then with a fine tipped iron, solder each pin. Repeat for the other strip.

Before breaking off the Molex support strips inspect the pc board around all soldering. Due to the proximity of conductors, it's fairly likely that a solder bridge may have been formed. These must be removed before continuing.

If you are happy with the construction so far, break off the Molex support strips and mount the transistors and IC1 (check orientation). Don't use a socket for IC1 since this may introduce future problems (the input from the photodiode will be in the order of nanoamps so a direct connection from sensor to IC is preferred). Take normal CMOS precautions when handling the ICs. Plug in IC2 and then finally, plug in the LCD display. ▶



View of the copper side of the pc board showing how the LCD is mounted.



View of the component side of pc board.

PARTS LIST — ETI-182

Resistors .... all 1/4W, 5%

R1, R6, R8	100k
R2, R4	1k
R3	27k
R5, R9	1M
R7	47k
R10, R11	4M7
R12	680k
RV1	100k ten-turn trimpot
RV2	1k ten-turn trimpot
RV3	100k trimpot
RV4	500k trimpot

Capacitors

C1	180p ceramic
C2	56p ceramic
C3, C5	100n, 50 V mylar
C4	100p NPO ceramic
C6	470n, 50 V mylar
C7	220n, 50 V mylar
C8	10n mylar

Semiconductors

IC1	CA3130
IC2	ICL7106
Q1	BC547, 8 or 9
Q2	2N5458, MPF106
D1	BPW21 photodiode.

Miscellaneous

SW1,2	DPDT miniature toggle switches

LAD204(or similar) liquid crystal display; ETI-182 pc board; Scotchcal front panel; 150 x 80 x 50 mm multi-purpose box; 9 volt battery clip; three 20 mm 6BA bolts (countersunk head); 9 nuts.

Price estimate: $45-$50

HOW IT WORKS

The block diagram shown in Figure 2 gives the overall operation of the unit. Very basically, illumination is converted into a current, current into voltage and then voltage into digital readout.

Photodiode D1 produces an output current proportional to illumination. If this is fed into a short circuit, the current versus illumination characteristic becomes extremely linear, an important feature for any light measuring instrument.

The CA3130 op-amp converts this current into a proportional voltage dependent on the value of the feedback resistance (the op-amp tries to make its input current equal to zero so it produces an output voltage which forces a current to flow through the feedback resistors to balance the input current from the photodiode). Capacitor C1 is included for stability.

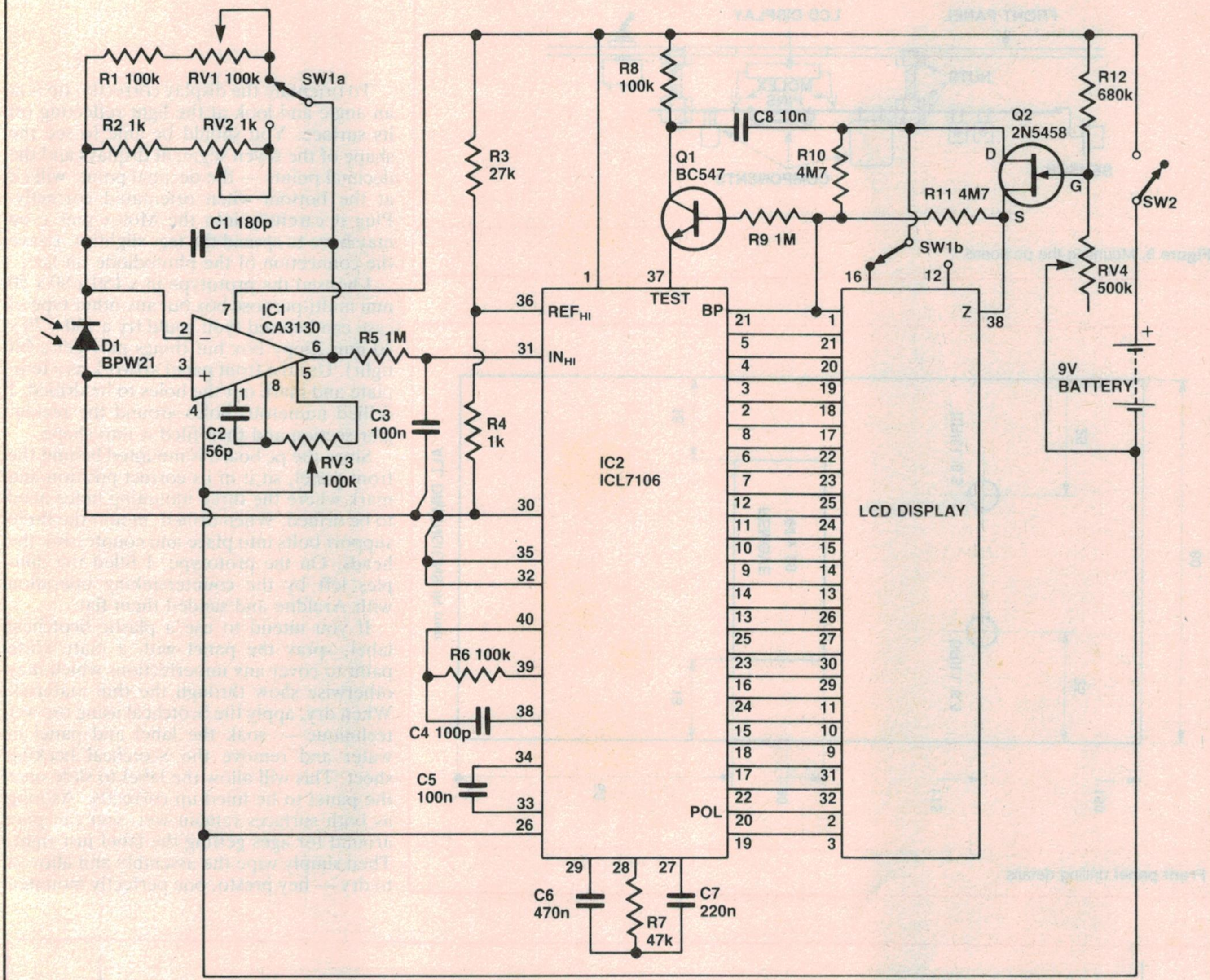
The output from the op-amp will contain an ac and dc component if mains operated lighting is being measured. R3 and C3 act as a low pass filter and reduce the 100 Hz component. The resultant voltage is fed into a ICL7106, a digital voltmeter IC which performs all the hard work of displaying its input voltage. More details of the operation of the ICL7106 can be found in the references given in the main text.

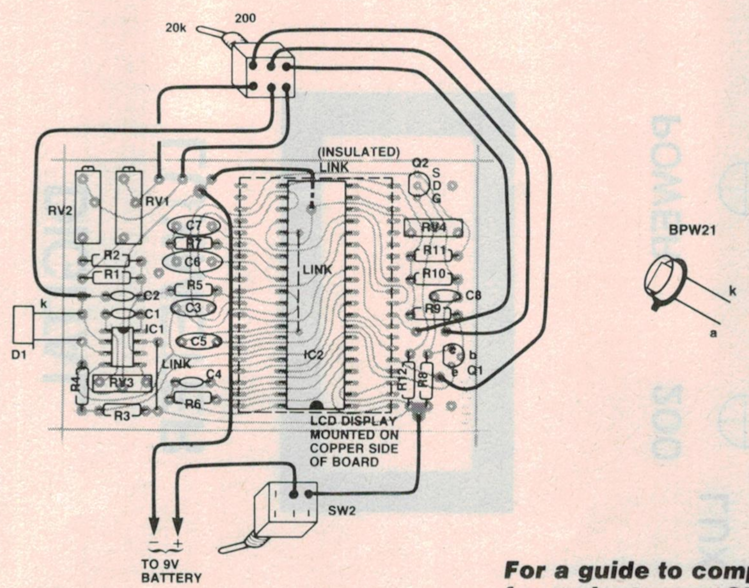
One interesting aspect of circuit operation is the method used to provide split rail voltages for the op-amp. The ICL7106 has a built in voltage reference of approximately 2.8 volts between pin 1 (Vcc) and pin 32 (common).

By connecting common, REF LO (pin 36) and IN LO (pin 30) together, this produces voltages of +2.8 and −6.2 to power the op-amp if measured with respect to the fake earth (junction of common, REF LO and IN LO). In actual fact, if the voltages are measured with respect to the negative terminal of the battery, the fake earth point is at +6.2 volts and Vcc is at 9 volts.

To provide a full scale reading of 200 mV, the voltage applied between REF HI and REF LO should be 100 mV. This is provided by voltage divider R3 and R4.

The rest of the circuitry switches the decimal points and performs the low battery monitoring function. This operates exactly as for project 161 Digital Panel Meter in ETI August '82 which can be referred to for more details.





For a guide to components and kits for projects, see SHOPAROUND this issue.

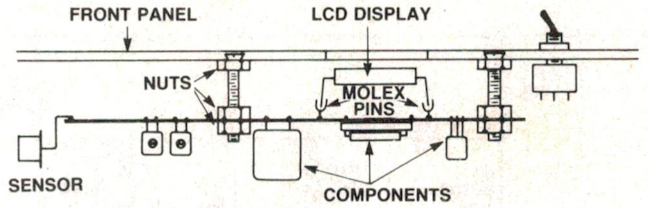
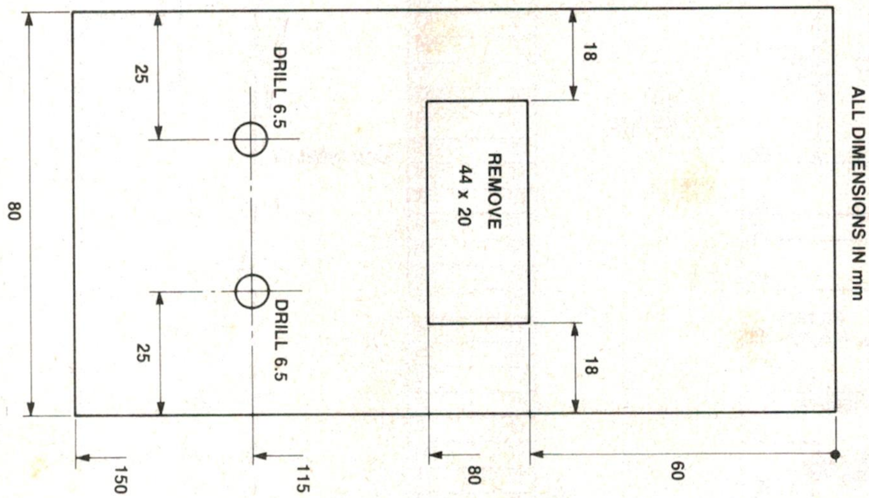
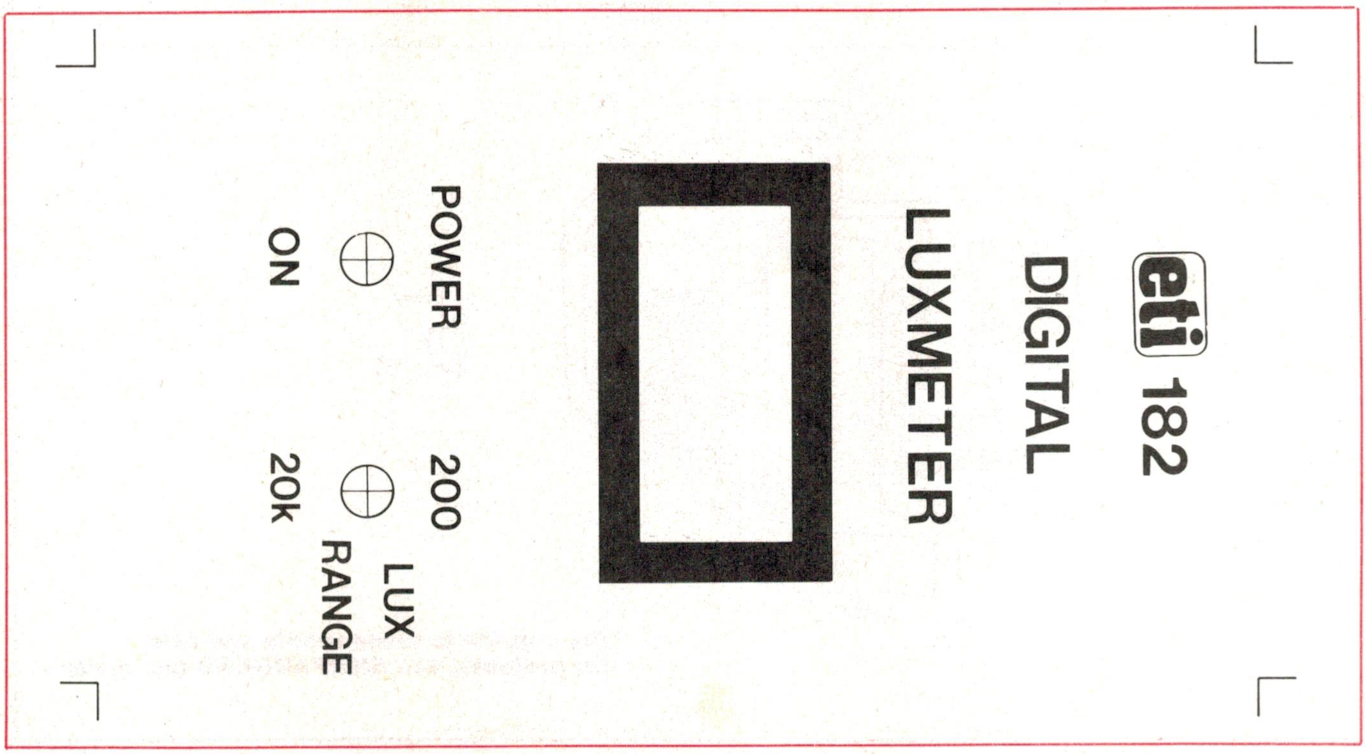


Figure 3. Mounting the pc board.



Front panel drilling details



To orientate the display correctly, tip it at an angle and look at the light reflecting off its surface. You should be able to see the shape of the seven segment displays and the decimal points — the decimal points will sit at the bottom when orientated correctly. Plug it carefully into the Molex pins (you may have to spread the legs slightly). Leave the connection of the photodiode till last.

I housed the prototype in a 150 x 80 x 50 mm multi-purpose box but any other type of case can be used (you could try a 130 x 75 x 40 mm Zippy box but things may get a bit tight). Use the front panel artwork as a template and mark out the holes to be drilled. I drilled numerous holes around the rectanglar section and then filed it into shape.

Since the pc board is mounted behind the front panel, sit it in its correct position and mark where the three mounting holes need to be drilled. When drilled, mount the three support bolts into place and countersink the heads. On the prototype, I filled the dimples left by the countersinking operation with Araldite and sanded them flat.

If you intend to use a plastic Scotchcal label, spray the panel with a matt white paint to cover any imperfections which may otherwise show through the thin material. When dry, apply the Scotchcal using the wet technique — soak the label and panel in water and remove the Scotchcal backing sheet. This will allow the label to slide over the panel to be lined up correctly. As long as both surfaces remain wet, you can play around for ages getting the label just right. Then simply wipe the assembly and allow it to dry — hey presto, one perfectly mounted ▶

label. Mounting dry Scotchcal onto dry panels only allows you one chance of getting it right — usually you miss.

Next, drill an 8 mm diameter hole in one end of the case to hold the sensor. If your particular case has internal ribs, remove those in the vicinity of the hole to allow the front window of the sensor to sit flush with the end of the case. Mount the two toggle switches and wire the unit as shown in the overlay diagram. Place another nut on each of the support bolts and fit the board into place. A final nut on each bolt will secure the board (refer to Figure 3).

Setting up

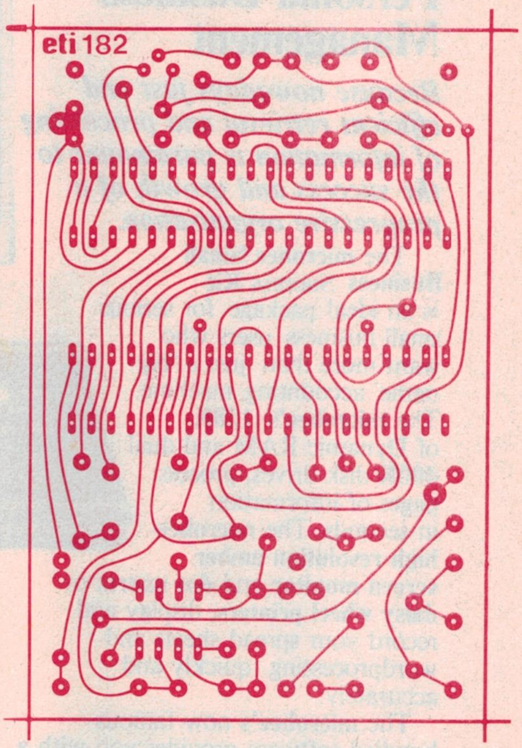
The first adjustment to be made is the offset trimmer RV3. This should be done BEFORE the photodiode is connected. Simply switch the unit on and adjust RV3 until the display shows 0. If this is not possible with your unit or if the reading on the display wanders randomly, check the orientation of semiconductors and all your soldering. It's no use continuing until this offset adjustment can be made.

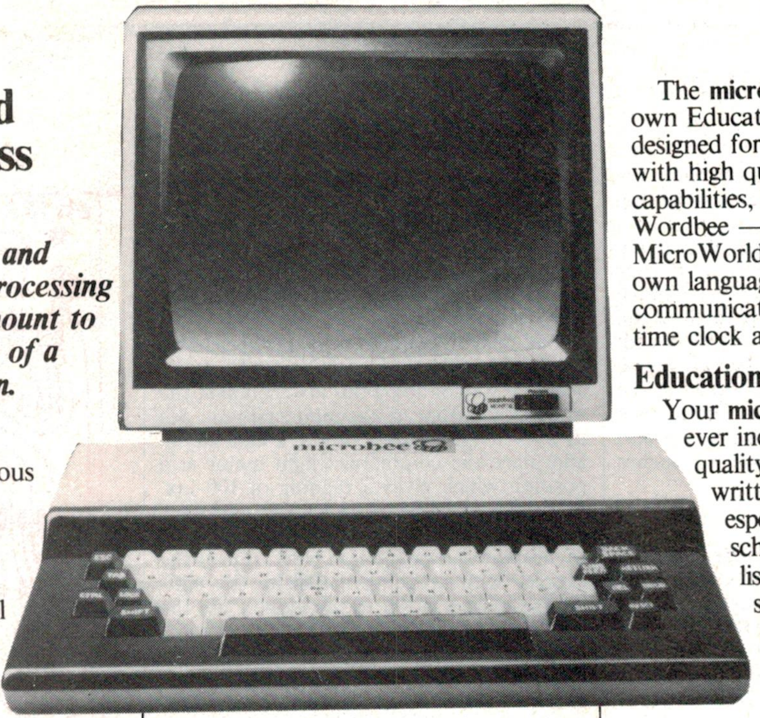
If all is well, the photodiode can be attached — check orientation carefully. Use some tinned copper wire to extend the leads by about 15 mm. To set the low battery warning trimpot (RV4), run the unit from an adjustable power supply set at 9 volts. Watch the reading carefully while decreasing the voltage. When the reading starts to differ drastically from the original, set RV4 so that the LO BAT indicator just comes on. Do not exceed 9 volts on the supply leads when doing this test.

The final adjustment to be performed involves the calibration of the unit. The most accurate way of doing this is to compare the reading with that of a commercial unit. Set up a fixed light source, such as a light globe, and place the commercial light meter at a position which gives a reading of 100 lux. Place the ETI-182 at this same distance, select the 200 lux scale and adjust RV1 until the display shows 100 lux. Next, repeat the exercise with a reading of 1000 lux (by shifting the meters closer to the globe), use the 20k lux range and adjust RV2.

If you don't have access to a commercial light meter, the following not-quite-so-accurate method can be used for calibration. Set up a 100 watt light globe in an area where there are no reflecting surfaces, brightly coloured walls or mirrors. The illumination level at 300 mm from the globe will be 1000 lux and at 750 mm, 160 lux. Simply place the meter at each of these distances and set the appropriate trimpots.

The unit is now ready for use. ●





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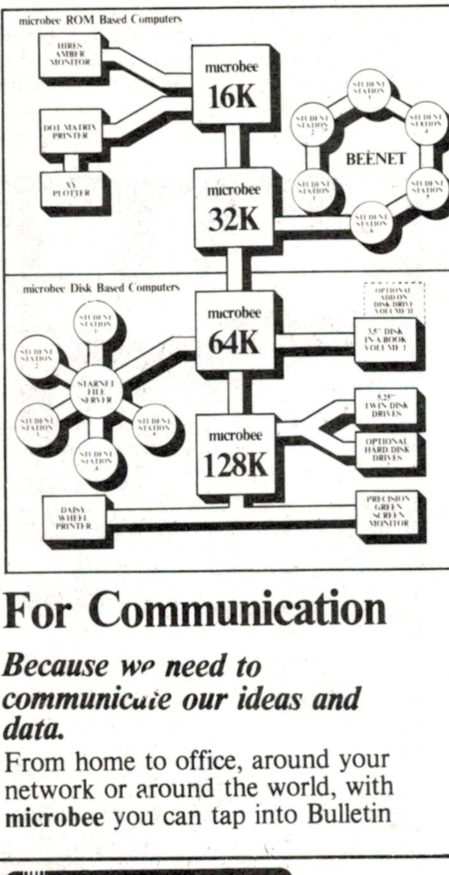

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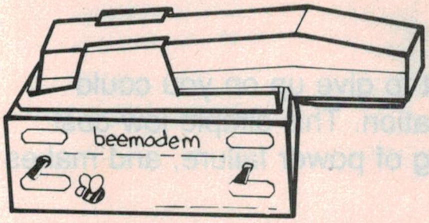

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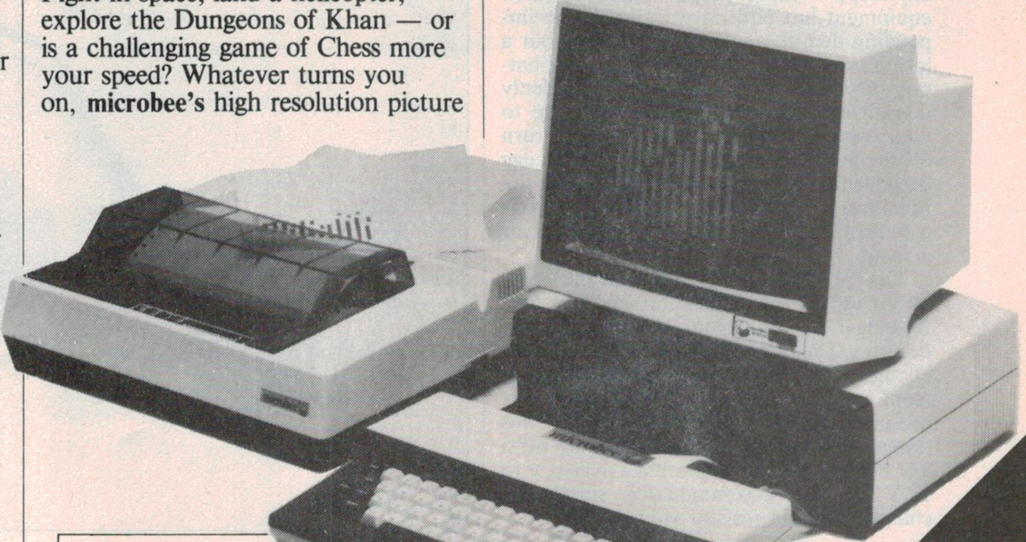

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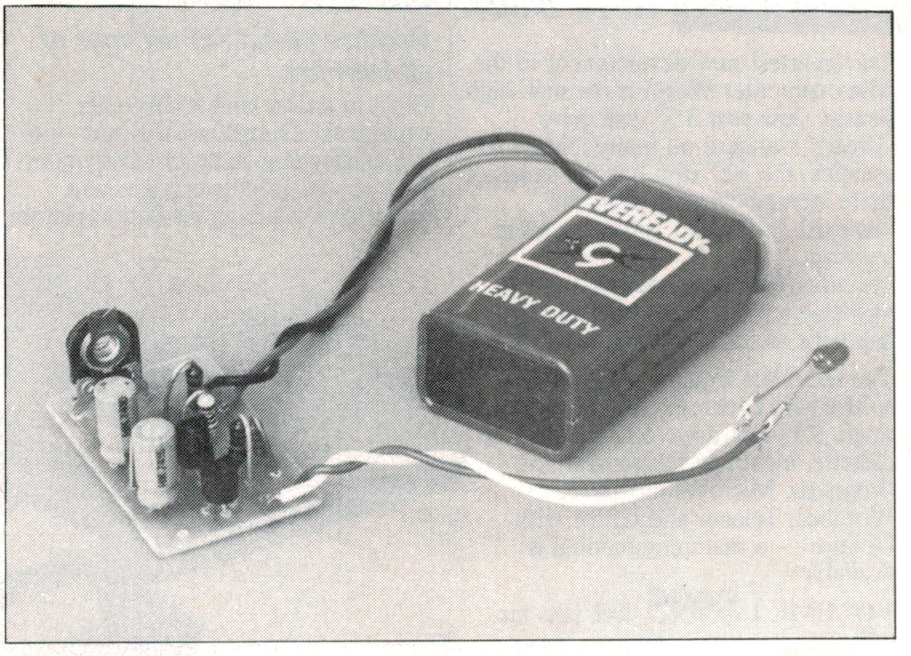
LOW BATTERY VOLTAGE INDICATOR

Knowing your batteries are about to give up on you could save many an embarrassing situation. This simple low cost project will give you early warning of power failure, and makes a handy beginner's project.

Robert Irwin

THE PERENNIAL PROBLEM with any piece of equipment run from some form of battery is to know that you're running out of battery power before the equipment actually stops working. Some battery powered equipment has built in warning of the impending demise of the power supply but a lot just keep you in the dark until your battery-powered super egg timer suddenly doesn't send the required strobe pulse to your computer which, in turn, fails to turn off the microwave and you end up with egg on your face and a divorce suit because the breakfast in bed that you meant to give your wife for the 25th wedding anniversary never arrived.

The ETI-280 can solve all these problems by giving a visual indication (by way of a flashing LED) that your battery is on the decline. The circuit is simple and small enough to be installed inside most equipment and requires no modification to existing circuitry. Although the prototype was designed to work from units working off a 9 V battery, any battery voltage from 6 V to 18 V can be accommodated simply by changing certain resistor values.



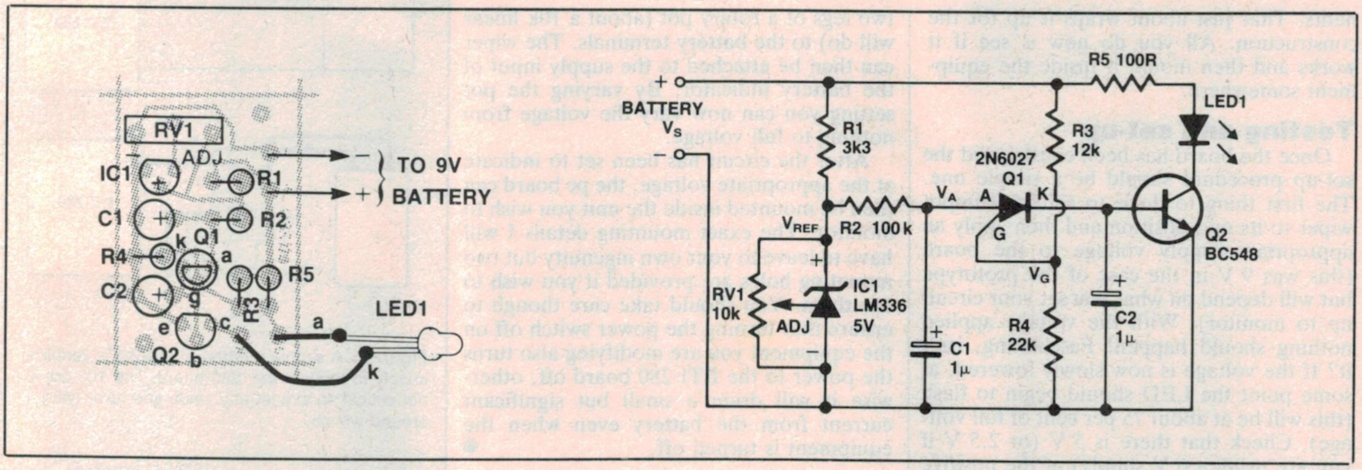
Design

The circuit uses a programmable unijunction transistor to sense the difference between a reference voltage and a monitor voltage (derived as a proportion of the battery voltage). To achieve a stable reference an LM336-5 V precision reference was used in preference to a zener because of its lower current drain. The circuit will draw 1 mA or less from the battery when in use. A relaxation oscillator circuit is used to flash an LED as a visual indication that the battery is failing. When the battery is in its 'operating' range (usually down to about 75 per cent of its rated voltage) the LED will remain off but when the voltage gets below the allowable minimum the circuit will activate and cause the LED to flash. As the battery voltage gets worse the LED will flash at a faster rate indicating that the battery is approaching exhaustion. The voltage at which the LED begins to flash can be adjusted over a limited range by adjustment of the control voltage of the LM336.

You will generally have about an hour or two of running time left after the LED has started to flash.

Different battery voltages

As mentioned earlier, the prototype was designed for use with 9 V battery equipment but, by suitable substitution of resistors, a variety of voltages can be accommodated. A Table is given for suitable component values for 6, 9, 12 and 18 volt operation. The method of selecting these values is given in the "How it works" section and this will allow you to work out your own values for any voltages not given in the Table.



PARTS LIST — ETI-280

Resistors

R1 .... 3k3
R2 .... 100k
R3 .... 12k
R4 .... 22k
R5 .... 100R
RV1 .... 10k trimpot

Capacitors

C1, C2 .... 1 µF, 25 V electro.

Semiconductors

Q1 .... 2N6027 programmable unijunction
Q2 .... BC548 or similar
IC1 .... LM336-5 V
LED1 .... 3.5 mm red LED

Miscellaneous

ETI-280 pc board; hookup wire.

Price Estimate: $5-$8

HOW IT WORKS — ETI-280

The heart of the circuit is a 2N6027 programmable unijunction transistor (PUT). A PUT acts a little like a SCR but can be turned off as well as on by the gate. Essentially, if the voltage on the gate drops to 0.6 V below the voltage on the anode, the PUT will start to conduct from anode to cathode. If the gate voltage is not lower than anode by more than 0.6 V then the PUT will be in nonconduction mode. In this circuit the PUT is used as a comparator. The anode voltage (Va) is held at a constant 5 V by the LM336-5 V precision reference. The gate voltage (Vg) is derived as a proportion of the supply voltage determined by the resistive divider network of R3 and R4. As the supply voltage falls (as happens when the battery begins to fail or is heavily loaded) the voltage, Vg, falls. When Vg falls to Va — 0.6 V (4.4 V) the PUT begins to conduct and turns on the transistor, Q2, which turns on the LED. To cause the LED to flash, C1 is configured as a relaxation oscillator. When Q1 conducts C1 is discharged quickly through the transistor and the anode voltage on Q1 drops. When it drops to a sufficient level the PUT will be turned off (thus turning off the LED and Q2). The capacitor, C1, will then charge up through R2 until the anode of Q1 is once again 0.6 V higher than Vg and the PUT turns on again. The cycle is then repeated.

Capacitor C2 acts to stretch the on time of the transistor so that the LED flash is not too short to be seen. R1 sets the bias current for the LM336 and R2 limits the current through the LED. RV1 allows a limited adjustment to the LM336 reference voltage over a range of about ±1 V.

The current drain of the circuit is around 1 mA or less. This is primarily determined by R1.

SELECTING COMPONENT VALUES

The Table given shows values for components for some of the more popular battery voltages. If you wish to use voltages other than those shown use the following criteria:

- R1 should be chosen to limit the current to 1 mA at full battery voltage, for example for 9 V R1 = (Vs — Vref)/1 mA (= 3.3 k to the nearest standard value).
- R3 and R4 should be chosen so that, at 75 per cent of full voltage, the voltage on the gate of the PUT is Vref — 0.6 V. Also, the total of R3 + R4 should be between 20k and 50k. For example for 9 V supply we want Vg = Vref — 0.6 V when the battery has dropped to 75 per cent of its full voltage, that is so R4/(R4 + R3) = (Vref — 0.6)/6.75. Choose R3 = 12k and R4 = 22k.
- R5 is not critical but should be chosen to limit the maximum current through the LED to about 80 or 90 mA.

It should be noted that for voltages less than 9 V, the reference should be changed to 2.5 V instead of 5 V.

Voltage (V)	R1	R3	R4	R5	IC1
6	3k3	22k	15k	100R	LM336 2.5 V
9	3k3	12k	22k	100R	LM336 5.0 V
12	6k8	22k	22k	220R	LM336 5.0 V
18	15k	22k	10k	220R	LM336 5.0 V

Table for determining component values for various supply voltages. Note that for 6 V operation an LM336-2.5 V reference is used instead of a 5 V reference.

Construction

The construction of the circuit is not critical. If you are adventurous enough you can use the pc board of the equipment you're adding the battery indicator to; drill a few holes in a spare space, then wire up the circuit on it. If you would rather not go playing round with the existing pc board then you can use the ETI-280 pc board. Give the board a good visual inspection and make sure there are no broken or shorted tracks. All components with the exception of the LED mount directly on the pc board. Begin with the resistors and capacitors. Note that the resistors are all mounted vertically to save space so you will have to bend one leg over to mount them. If the board is going to be mounted in a tight space near other components it may be wise to put an insulation sleeve over the long leg of the resistor so that it won't short out on anything. Make sure that you take note of the polarity of the capacitors. The two transistors and the IC can be mounted next. Once again take careful note of the polarity of these compo-

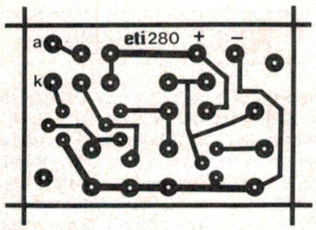
nents. That just about wraps it up for the construction. All you do now is see if it works and then mount it inside the equipment somewhere.

Testing and set-up

Once the board has been constructed the set-up procedure should be a simple one. The first thing to do is to set the trimpot wiper to its mid position and then apply an appropriate supply voltage to the board (this was 9 V in the case of the prototype but will depend on what you set your circuit up to monitor). With the voltage applied nothing should happen! Fascinating, isn't it? If the voltage is now slowly lowered, at some point the LED should begin to flash (this will be at about 75 per cent of full voltage). Check that there is 5 V (or 2.5 V if you are using a 6 V supply) at the positive pin of the LM336. If the supply voltage is lowered still further, the LED will flash faster. The point at which the LED begins to flash can be adjusted by the setting of the trimpot.

The above set-up can easily be done if you have a variable power supply. If not, then you can make a simple variable supply with a battery and a pot. Just get a battery of the same voltage as that which you have set your circuit up to monitor and solder the two legs of a rotary pot (about a 10k linear will do) to the battery terminals. The wiper can then be attached to the supply input of the battery indicator. By varying the pot setting you can now vary the voltage from nothing to full voltage.

After the circuit has been set to indicate at the appropriate voltage, the pc board can then be mounted inside the unit you wish to monitor. The exact mounting details I will have to leave to your own ingenuity but two mounting holes are provided if you wish to use them. You should take care though to ensure that turning the power switch off on the equipment you are modifying also turns the power to the ETI-280 board off, otherwise it will drain a small but significant current from the battery even when the equipment is turned off. ●



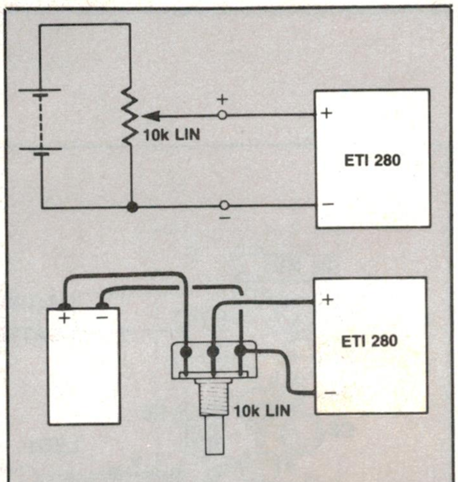


Figure 1. A simple method of making a variable supply to test out the '280 board. The 10k pot is not critical so almost any value you have lying around will do.

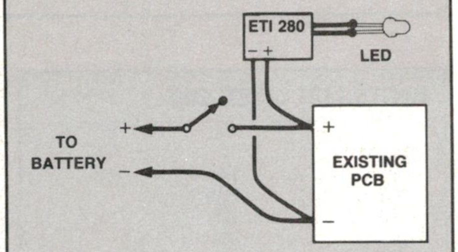


Figure 2. Wiring the ETI-280 into a circuit. Note how the ETI-280 is hooked in after the ON/OFF switch.

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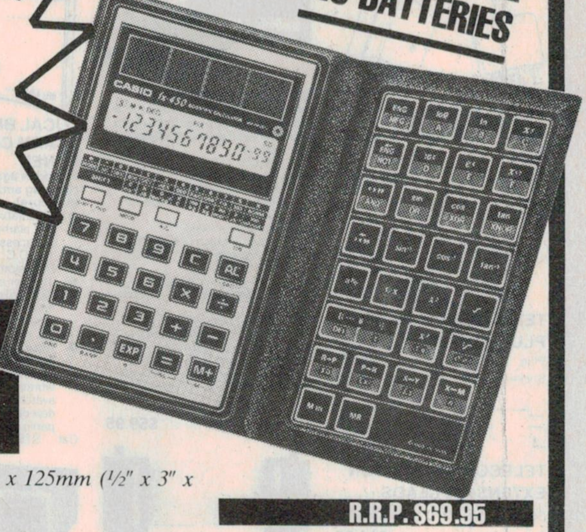

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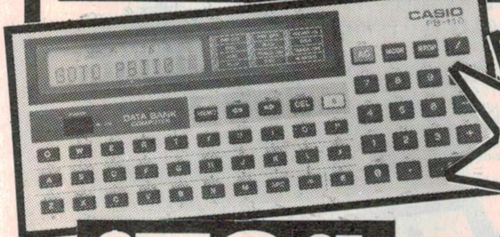

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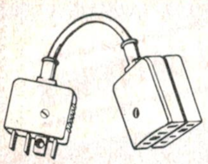

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Ideal for modem connections.
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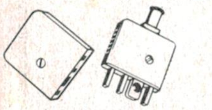
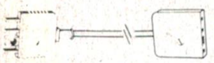
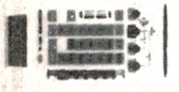


TELECOMMUNICATION PLUG/SOCKET
Plug Cat. Y1601 **$3.95**
Socket Cat. Y16018 **$4.95**



TELECOMMUNICATION EXTENSION LEADS
Cat. Y16010 5m **$12.50**
Cat. Y16012 10m **$14.95**

NATIONAL RECHARGEABLE DRILL/SCREW DRIVER EZ505
★ Quick 1Hr Charging
★ 4 Stage Torque Control
★ 2 Speed Switch
★ Handle Storage Compartment
★ Forward/Reverse Operation
★ National Quality
★ Spare Battery Pack Available
Cat. T12320 **$149.00**



DIGITAL MULTIMETER
YFE YF1100 FEATURES
- Large easy to read 3 1/2 digit display
- Facilities for transistor and diode testing
- Clearly laid out front panel
- 10A DC AC range
- Priced to undersell the others

Cat. A16025 **$59.50**

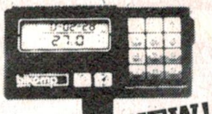
WE HAVE DONE IT AGAIN!!
New multimeter at unbeatable value for under $45! The new YU-FONG YFE-1030C features:
- Large 3 1/2 digit display. (1/2 inch high)
- Autopolarity, "-" display for Negative input
- High over-load protection for all ranges
- Over-load display highest figure "1" or "-1" alone glows
- Power consumption 20mW approx.

Cat. **$44.95**

RELAY AND BASE
Can carry 10A at 28V DC or 5A at 240V AC. Supplied with Chassis Mounting Socket with screw terminals. Great for school projects and demonstrations, switching DC power supplies, central circuits and with contacts parallel up to 20A can be switched.
Normally $8.95
Cat. S140/4 This month **$6.95**

MAGNETIC REED SWITCHES

	1-9	10+
N.C. Cat. S15057	$1.95	$1.85
N.O. Cat. S15058	$1.95	$1.85



NEW!!

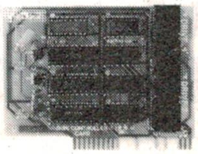
BICYCLE COMPUTER
Fantastic 12 function, dual L.E.D. Display, very popular in the USA and now available at Rod Irving Electronics
FEATURES:
- 3 Speed functions: Instaneous,Average speed and Maximum speed reached.
- Distance travelled.
- Target Distance (Perfect for training) with 1/4, 1/2, 3/4 bar graph display.
- Pacer: Audio, 2 Speeds.
- Clock/Stopwatch/Journey time
- Calories used.
- Miles or Kilometres.
- Memory: Time, bodyweight, type, size, target size, target distance.
- Friction free magnetic sensor.
- Easily fitted, easy to detach for security.
- 90 Day Warranty.

Cat. **$59.95**

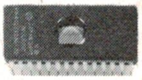
READY MADE CABLES
Serial to Serial
Cat. P19011 **$23.50**
Parallel centronics to centronics.
Cat. P19013 **$34.50**

TELECOMMUNICATIONS CABLE

2pr.	Cat. W11302	**$0.75m**
3pr.	Cat. W11303	**$0.90m**
10pr.	Cat. W11310	**$1.95m**



APPLE COMPATIBLE CARDS
Printer Card **$65.00**
Cat. X17029
Drive Card **$80.00**
Cat. X17019



NEW IC'S

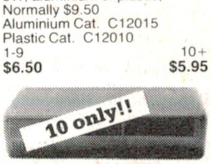
	1-9	10+
41256	$24.95	$23.95
27128	$19.50	$18.75
74HC02	$ 0.50	$ 0.40
57716 R.F.Mod	$64.95	$59.95

SAVE!

P.A. SPEAKERS
Low dual cone, wide range, 200mm (8in.). Ideal for public address, background music, etc. Tremendous Value at these prices!
Cat. C12000 1-9 10+
$5.95 $4.95

ECONOMY 19" RACK CASE
Cat. H10400 1-9 10+
$34.95 $29.50

HORN CRAZY!!
8W, aluminium or plastic.
Normally $9.50
Aluminium Cat. C12015
Plastic Cat. C12010
1-9 10+
$6.50 $5.95



PLASTIC COMPUTER CASING
A stylistic low profile case to give your system the professional look it deserves. Provision for two 5 1/4" slimline drives.
Cat. X11080 **$75.00**

ALARM PRODUCTS!

LOCAL BURGULAR ALARM CONTROL PANEL
The odds against you are climbing and prevention is better than cure!
- Adjustable exit/entry time delay and alarm time (avoids unnecessary noise pollution)
- 12V D.C. 1.5Amp
- Provision for battery back-up.
- Tamper switch
- Optional outputs: Sirens, bells, floodlights, automatic diallers, tape recordings, closed circuit TV, etc.
- Accepts N.C. and N.O. detectors such as infrared, microwave, ultrasonic, wireless, vibration sensor, magnetic switch, door mat, smoke detector,glass breakage sensor panic button etc.

Cat. S15051 **$79.95**

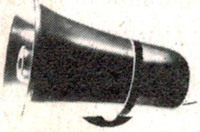
ULTRASONIC BURGULAR ALARM
- Easy to install
- Connect with magnetic switch, infrared detector, etc.
- Equip with hornspeaker, lockswitch, flashlight, closed circuit TV, etc.
- Rechargeable battery circuit with recharge indicator L.E.D.
- N.O. and N.C. circuit breakdown indicator
- Low dry battery indicator

Cat. S15052 **$89.95**

GLASS BREAKAGE DETECTOR
Adjustable for closed circuit or open circuit type glass. Instructions supplied.
Cat. 15060 **$3.95**

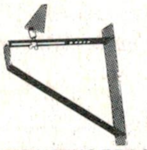
4" BELL
12V D.C. 250mA
Cat. S51072 **$9.95**

MINITURE BUZZER
5-15V White or black.
Cat. A15062 1-9 10+
$1.95 $1.75



HORN SIREN
12V DC, 8W
Cat. C12012 1-9 10+
$14.95 $13.95

ULTRASONIC MOTION DETECTOR
A compact design that can be used with virtually any alarm system which has an input for N.C. or N.O. external sensor. Coverage is approximately 110 degree angle and up to 8 metres. Comes with detailed instructions.
Cat. S15033 **$39.95**



MOUNTING BRACKET
For above Ultrasonic Alarm and features ball pivot for horizontal and vertical adjustment.
Cat. S15042 **$11.95**

NOW IN STOCK, 'TALKING ELECTRONICS' KITS!

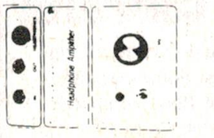
In addition to our 300+ EA/ETI kits, we now have over 50 'Talking Electronics' kits!

Kit	Cat.	Price
BLACK JACK	K80001	$11.00
CAPACITANCE METER	K80002	$6.25
CLOCKS incl. PCB	K80003	$22.80
CLOCKS without PCB	K80004	$19.50
COMBINATION LOCKS	K80005	$7.50
COUNTER MODULE	K80006	$21.70
7 SEGMENT DISPLAY	K80007	$11.40
CUBE PUZZLE	K80008	$17.90
DIGI CHASER	K80009	$17.40
DIODE TESTER	K80010	$3.30
KEN'S DUAL PSU.	K80011	$11.80
DUAL TRACKING PSU.	K80012	$18.90
8x8 DISPLAY	K80013	$22.80
DUAL TRACKING PSU. (without PCB)	K80014	$15.60
EGG TIMER	K80015	$8.30
8W AMPLIFIER	K80016	$9.70
EXPERIMENTER BOARD	K80017	$14.30
EXPERIMETER DECK	K80018	$17.55
HANGMAN with PC	K80019	$12.50
FM BUGS	K80020	$6.80
HANGMAN with no PC	K80021	$9.20
HEADLIGHT REMINDERS	K80022	$12.90
IC POCKET RADIOS	K80023	$10.80
LED DICE	K80024	$9.05
LED ZEPLINS	K80025	$7.85
LIGHT THE LED	K80026	$4.60
LOGIC DESIGNER (with PC)	K80027	$20.90
LOGIC PROBES	K80028	$11.55
LOGIC DESIGNER (without PC)	K80029	$17.60
LOTTO SELECTORS	K80030	$16.50
MINI FREQUENCY COUNTER (no PC)	K80031	$15.60
MINI MIXER	K80032	$3.90
NOISE A TRON	K80033	$5.30
MINI FREQUENCY COUNTER RED	K80034	$18.90
MINI FRE COUNTER GREEN SCREEN	K80035	$22.10
MUSIC COLOUR	K80036	$9.90
PHASER GUNS	K80037	$7.20
PILL TIMER	K80038	$7.90
POWER SUPPLY LAMP	K80039	$6.50
5 PRINTER INTERFACE	K80040	$28.60
PROGRAMMABLE COUNTER	K80041	$11.80
AUTO RESET	K80042	$9.70
QUICK DRAW	K80043	$3.90
RAM STACKS	K80044	$9.70
RELAY DRIVER BOARD	K80045	$28.40
ROULED	K80046	$8.50
SQUARE WAVE OSCILLATOR	K80047	$4.70
STEREO MINI MIXER	K80048	$23.10
STEREO PRE AMPS	K80049	$13.20
SIMPLICITY AMPS	K80050	$6.80
STEREO VU METERS (no PC)	K80051	$10.70
TRAIN SIGNALS	K80052	$7.70
STEREO VU METER (with PC)	K80053	$14.00
TOUCH PUZZLE	K80054	$6.25
TRAIN THROTTLE MK11	K80055	$4.30
TREMOLO	K80056	$3.80
TEC 1A	K80057	$95.00
STAGE-1 KIT	K80058	$89.95

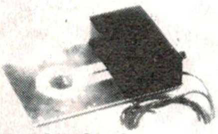
ELECTRIC FENCE
Mains or battery powered, this electric fence controller is both inexpensive and versatile. Based on an automotive ignition coil, it should prove an adequate deterrent to all manner of livestock. Additionally, its operation comforms to the relevant clauses of Australian Standard 3129. (EA Sept. '82)
82EF9 **$19.50**

EA AM STEREO DECODER
AM stereo is now broadcast in Australia on an experimental basis. This add-on decoder works with the Motorola C-QUAM system. (EA Oct. '84, 84MS10)
Cat. K84101 **$24.95**

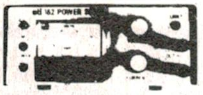
150 W BASS AMP
This guitar amp for impeccable bass players features many facilities found on expensive commercial ones. It delivers 150 watts into 4 ohms, has a 1-band graphic, limiter, line out and bi-amp facilities. (ETI Aug '84, ETI-1410)
Cat. K54100 **$299.00**



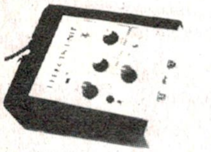
HEADPHONE AMPLIFIER
PRACTISE WITHOUT ANNOYING THE FAMILY!
If you play any type of electronic instrument, this headphone amplifier will surely interest you. It will let you practise for hours without upsetting the household, or you can use it to monitor your own instrument in the midst of a rowdy jam session. (EA Feb. '84)
83MA11 **$28.00**



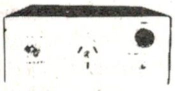
ELECTRONIC MOUSETRAP
This clever electronic mousetrap disposes of mice instantly and mercifully, without fail, and resets itself automatically. They'll never get away with the cheese again! (ETI Aug '84)
Cat. ETI 1524 **$29.95**



30 V/1 A FULLY PROTECTED POWER SUPPLY
The last power supply we did was the phenomenally popular ETI-131. This low cost supply features full protection, output variation from 0V to 30V and selectable current limit. Both voltage and current metering is provided. (ETI Dec. '83)
ETI-162 **$49.50**



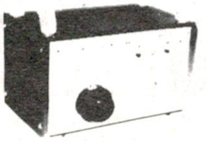
EFFECTS UNIT
An "effects unit" that can create phasing, flanging, echo, reverb and vibrato effects.
(EA June '83)
83GA6 **$65.00**



INVERTER
This 12/240V inverter can be used to power mains appliances rated up to 40W, or to vary the speed of a turntable. As a bonus, it will also work backwards as a trickle charger to tup up the battery when the power is on.
(EA May '82) **$49.50**

COMPUTER DRIVEN RADIO-TELETYPE TRANSCEIVER
Here's what you've all been asking for — a full transmit-receive system for a computer-driven radio teletype station. The software provides all the latest "whizz-bangs" like split-screen operation, automatically repeating test message, printer output and more. The hardware uses tried and proven techniques. While designed to team with the popular Microbee, tips are available on interfacing the unit to other computers. (ETI Nov '84, ETI-755)
Cat. K47550 **$139.00**

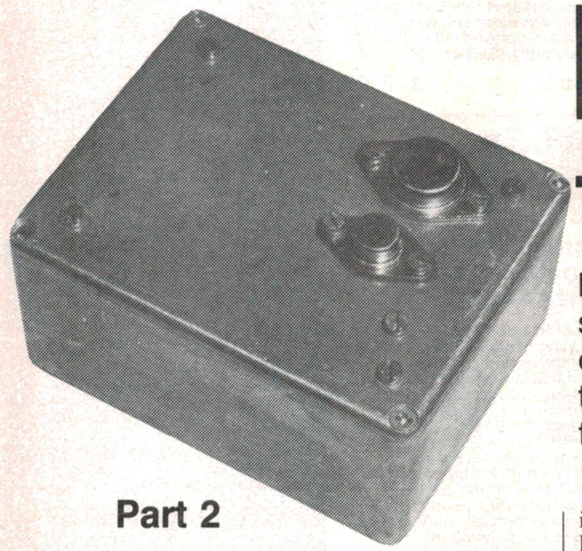
1 W AUDIO AMPLIFIER
A low-cost, general-purpose, 1 watt audio amplifier, suitable for increasing your computers audio level, etc. (EA Nov. '84)
$9.95



12-230V DC-AC INVERTER INCLUDING TRANSFORMER 300 WATTS
This EA Inverter is capable of driving mains appliances rated up to 300VA and features voltage regulation and full over load protection. (EA June '87)

Nominal Supply Voltage	12V DC
Output Voltage	see table
Frequency	50Hz/± .005
Regulation	see table
Maximum Load	300VA
Current Limiting	30A (primary)
Efficiency	see table

P & P $10.00 Anywhere in Australia **$195.00**



IMPROVED CDI

— using shaped pulses

Last month we started our description of an improved CDI system. Capacitor discharge ignition systems are much more efficient than conventional or transistor assisted systems, and they're also much better at getting maximum performance from today's engines.

Ian Thomas

Part 2

LAST MONTH this new pulse shaped capacitor discharge ignition system was introduced, sketching the background problems the systems have incurred up till now and detailing requirements for a successful CDI. Having dealt with such delicacies as cross firing, soaring temperatures and circuitry the next step is to build the device.

Construction

The CDI is constructed quite conventionally and I chose to build mine into an Eddystone diecast aluminium box 94 x 119 x 53 mm (Jaycar #HB5020). The all aluminium boxes are far better as they're stronger and make a useful heatsink for the power devices. The board layout nicely fits (that is only just!) in the lid of the box and that's where it's mounted. You can do your own artwork but it's a lot easier to buy it from ETI or you can buy a ready made board. If you decide to tape up your own remember that *very high currents flow around the inverter primary*. As much copper as possible must be left. Once the board is etched and drilled use it as a template to drill the four mounting holes in the lid of the box.

Next use the mica heatsink insulators provided to mark out the holes for the two power transistors. Drill out the four holes for each transistor and drill another to mount D10. It's hard to say what size holes to use as the mounting hardware varies but I recommend that about 4.5 to 5 mm be used to clear the transistor leads. The transistors should be mounted in the end of the box nearest the terminal pads where leads from the transistors attach to the board. Don't forget Q1's collector lead carries an average 8 amps when the inverter's running. Mount the transistors using heatsink grease and the mica spacers between the transistors and the lid.

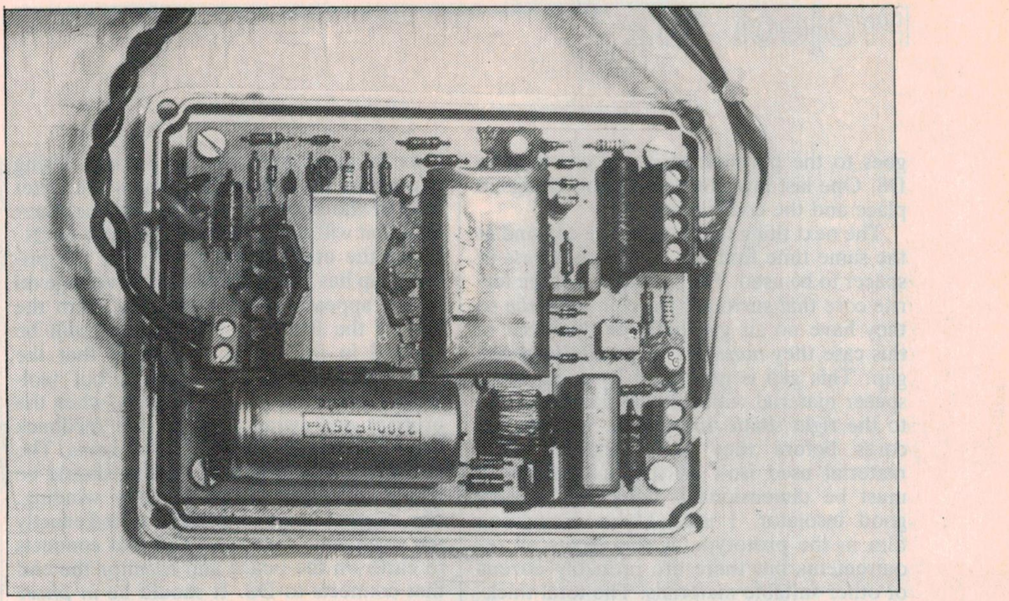
Cut four pieces of insulating sleeving about 5 mm long and slip over the transistor leads (I used silicon rubber sleeving which is to be preferred as it doesn't mind a bit of heat). This ensures that if a metal fragment falls into one of the holes it doesn't cause disaster. Next connect the emitter of Q2 to the base of Q1 and wire in R21 between the base and emitter of Q1. Diode D3 can be soldered between the terminal tag on the collector of Q1 and its emitter. Finally mount D10 using an insulating spacer and a *small* amount of heatsink grease, and assembly of the components on the heatsink is complete.

The next thing to do is to wind the two inductors. L1 is by far the most important and, as it must handle both very high currents and voltages some special materials are needed. The inductor is wound on a TDK type PQ32/20 core using H7C1 ferrite material. These cores are distributed in Australia by GEC who (praise be!) have a cash sale counter in their warehouse at 2 Giffnock Ave, North Ryde NSW. If you can't get there then I suppose you're at the mercy of the distributors. These cores are specifically designed for switching regulators and are suprisingly small for their performance. They come complete with a coil former that's essential. In the inverter core when it's running flat out there are expected losses of about 2 watts in the worst case so the interior of the coil gets a spot warmish. For this reason (amongst others) the bog standard PVC insulating tape just isn't good enough. The tape to use, which can be found in all industrial and commercial equipment, is polyester insulating tape. Normally you can't get the stuff from Jaycar and certainly not from the ubiquitous Richard. It's marketed in Australia by Beiersdorf (Australia) in North Ryde. They don't sell direct to the public but a phone call will tell all. Alternatively look in the 'Where to get it' section (Shoparound) at the back of this magazine. The stuff is TESA Type 4107 Polyester Electrical Tape and it's very handy to have around. I use it in almost all applications. Back to winding the coil.

The winding width available in the core is only 9 mm so if you've got insulating tape 12.7 mm wide (the usual size to be stocked) you'll have to cut it down. The easiest way to do this is to lay down about 200 mm of tape on a piece of glass and trim one edge with a sharp blade and steel rule. Don't even try trimming it with scissors. If it sticks to itself it *cannot* be unstuck! Trim a few pieces of tape and leave them on the glass to be used when necessary.

The coil is wound with a layer of secondary then the complete primary then a second layer of secondary. Finally the base feedback and trigger power windings go on the outside. The secondary which goes on first consists of about four metres of 0.35 mm diameter wire. Cut two pieces of insulating sleeving (once again I used silicon rubber sleeving and here it's more important) each about 20 to 25 mm long and slip over the ends of the wire. The sleeving is to insulate the ends of the winding where they emerge from the coil to prevent any nasty flashovers. Push one piece right down on the wire as it isn't used until the end of the first half of the winding. Take the coil former and hold it so the pins point towards you and start the winding going *to the left* from the pin end of the former. Make sure that the silicon sleeving reaches to the terminal pins but not too much further and continues about a quarter turn into the coil.

Wind on wire tightly but don't allow it to ride over the previous turn. Every five turns or so push the wire hard down so the turns are tightly packed and neat. Wind on 24 turns and use the second piece of silicon sleeving to insulate the last quarter turn as the wire comes out of the top of the former. Take one of your pretrimmed pieces of wire and cover the winding with two to three complete layers of tape. If any of the winding can be seen at all after you've taped it you'll have to redo it. A secondary to primary breakdown would be catastrophic. The final result at this stage should be a nice pretty coil with sleeved wires protruding from either end. Be super careful not to break the two metres of wire protruding from the top of the coil as this forms the other half of the secondary. Also



make sure that there is sufficient sleeving to cover the wire as it goes over the primary winding and back into the coil.

Next the primary has to go on. This consists of seven turns of 1.1 mm diameter wire tapped at three turns; 0.7 m is all that's needed. To start bend one end of the wire very sharply at right angles *and tin the end of the wire up to 7 mm from the bend.* This is so you don't have to tin the wire on the coil and risk damaging the insulation. Next hold the coil former as before and start the winding from the pin end of the coil going *to the right:* that is, the primary is wound in the opposite direction to the secondary. Wind on all seven turns tightly spaced and bend the end of the wire straight out the top. It *must* be exactly seven turns and they must be even and tightly packed (although if you use the right wire there's no way to loose pack them!). The final result here should be a neatly wound coil with the two ends *on the opposite side of the former to the secondary.* It helps to look at the board layout to see where you want to have the leads come out.

Next count up three turns from the bottom of the coil and scrape off the insulation with a sharp pointed blade. This is to make the tap for Q2's collector so make sure the winding goes around the coil three times exactly before coming out where you're scraping away the insulation. Be painfully careful not to damage the insulation but try to bare the copper in the groove between the turns so the soldered on tap doesn't make too big a bulge. The wire should be bare for about 5 mm in a strip 1 mm wide. Next tin the bared copper *being quick so as not to damage the insulating tape;* it's heat resistant but it has its limits! Take a piece of the wire used for the secondary about 50 mm long and tin its end for 5 mm. Lay the tinned end next to the tinned tap point so the two tinned areas lie next to each other and touch them with the soldering iron. The solder should flow to make a nice neat lap joint *with no dags or spikes of solder.* Any sharp points may damage the next insulating layer.

It's a good idea at this point to examine the joint under a magnifying glass as now problems are easy to fix but later not so easy. Finally cover the primary with another two to three complete layers of tape. Once again you should be left with a nice smooth yellow coil former only this time you have two wires protruding from either end of both sides of the former. The tap should come out where the primary winding was started. If you want, now is a convenient time to terminate the tap as even if you've made a mistake in the direction of the windings the tap will go to the same place. Holding the former as you've been doing for all the windings the tap goes to the third pin from the end or the pin just to the left of the centre gap in the row of pins. Tin the tap to within 5 mm of the coil and wrap it once around the pin then solder it in place making sure it's pushed hard up against the body of the former. Don't stretch the wire tight as it comes out of the coil as this makes for an unreliable coil. Better to leave a little slack.

Next comes the second layer of the secondary. At this stage, even with the best efforts in the world, you'll have a few lumps in the tape you have to wind on. You probably won't be able to get another full 24 turns on. Not to worry — the exact turns ratio isn't all that critical. Wind the next layer from the top down so the silicon sleeving completely protects the secondary from the primary with once again nice, neat tightly packed turns. *Wind them in the same direction as you did the first half!!!* If you wound them the other way they would cancel the first half out and all you'd get out of the inverter is smoke! I only fitted 21 turns on the prototype but even less wouldn't matter too much. The main effect of far too few turns would be to shorten the rise time of the output pulse to the ignition coil. Try to squeeze on the full 45 turn total for both halves. When you've finished the secondary, cut another piece of sleeving and slip it over the end of the wire. Sleeve the last quarter turn and bring the end out the same side as the secondary was started. Cover the secondary with another three layers of insulating tape and it's complete. It's a good idea not to terminate the secondary onto the pins until testing is complete.

The feedback and trigger windings are the next step and if you've come this far they're a snip. As both windings are brought out to pins away from the centre gaps in the rows of pins it doesn't matter which way you wind them all that much but in case you have trouble getting the necessary test equipment I'll describe how to get them right.

Wind the feedback winding using the same wire as you used for the secondary. As there are 16 turns you'll need about 1.5 m. (I usually estimate lengths generously as it's easier to cut a bit off than join some on!) Wind the feedback winding in exactly the same way as you wound the primary, starting from the same point. You can leave a millimetre free at the bottom of the former as the winding won't (shouldn't) fill the whole former. As before take the winding out of the top of the former and cover it with tape, but here one or two layers are sufficient. If you're absolutely sure it was wound the same way as the primary you can now terminate it but I suggest you leave plenty of slack in case you have to reverse the winding. The start or pin end of the winding goes to the second pin from the left or the centre pin in the left hand bank of three. In the circuit layout it goes to ground so hold the former over the board to make sure you're right before soldering it on. The end away from the pins goes to the far right pin in the group on the primary side and is the end that connects to ZD1 and C3.

Finally you can wind on the trigger power winding. Use the same wire as before but this time only three turns are needed. First cover the feedback winding return with a small piece of tape. The enamel would probably be able to cop the voltages generated but it's best not to push your luck! Then wind on the three turns in the centre of the winding space exactly as you did for the feedback and primary windings and in the same direction. However, *the trigger power winding goes on the side of the coil where the secondary ends come out.* The start or pin end of the windings goes to the output ground or the far right pin in the output bank of six pins and the top or finish end ▶

goes to the pin next to it and connects to D8. One last layer of tape to hold things in place and the coil is complete.

The next thing to do is test the coil and at the same time find the correct thickness of spacer to be used. The two halves of the ferrite core that surround the coil are made so they have no air gap between them but in this case they *must* have a precisely spaced gap. This gap is generated by using some spacer material with suitable properties cut to the right shape and placed between the cores before they are assembled. The material used isn't all that critical but it must be dimensionally stable and a very good insulator. I used Mylar draughting film in the prototype as this meets all requirements but there are probably dozens of other suitable materials. The total thickness needed is 0.5 mm with a tolerance of about 10 per cent.

The easiest way to make sure the thickness is correct is to test the inductor to make sure it's okay as this really is the bottom line. To test the inductor it's easiest to use the dump capacitor you've already bought. Connect it in parallel with the coil primary and cut small pieces of the film you intend to use that fit into the hole in the coil former.

Assemble the cores around the former and loosely hold them in place. Connect an audio oscillator across the parallel capacitor-inductor combination. The oscillator should have an output impedance of 600 ohms and if it's lower use a padding resistor. Use a CRO or DVM with an ac response going *up to 50 kHz* (if you're not sure dig out the specifications) and monitor the voltage across the resonant circuit. Adjust the frequency until you find the resonance. It should be at around 27 kHz. If it's less than 25 kHz then you need more spacer material and if it's more than 30 kHz you need less. Make sure the two core halves are held tightly together but only clamp them in the centres where there's spacer material; they are by no means unbreakable. Once you've got the spacer material right cut enough circular pieces for the centre leg of the core and equally long thin pieces for both ends. Assemble the core with all three legs having exactly the same thickness of spacing material. For your interest the prototype had four thicknesses of 0.13 mm thick draughting film.

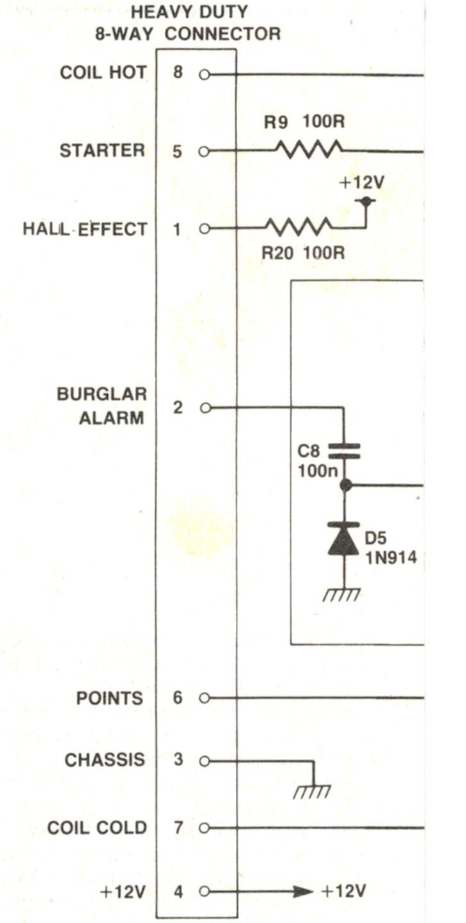
Once the core is assembled and the core clamp in place the core is ready for final test. At this stage the top of the primary lead is still probably sticking straight up. Carefully bend it down so it will go into the hole in the board and tin it up to the height of the former pins. I used a dual beam CRO for final test as this is by far the easiest way to check everything. Once again tack the dump capacitor across the primary leads and drive the coil capacitor from a 600 ohm or more source. The resonance which should be very sharp, should be at around 27 kHz again. With the primary at resonance, monitor the other windings as follows to make sure they're correct. Using one probe from the CRO, earth the outer lead of the primary and monitor the inner lead that will connect to the collector of Q1. Using the other probe check that the primary tap has four sevenths of the voltage on it that appears at the end. Next earth the end of the feedback winding that will be earthed in the board and check that the 'hot' end is *in anti-phase* with the 'hot' (collector) end of the primary: that is, when the primary end swings positive the feedback winding swings negative and vice versa. The voltage on the feedback winding should be sixteen sevenths of the primary winding. The trigger winding should be tested exactly the same way. Earth the end that connects to earth on the board and monitor the end that connects to D8. It should be *in phase* and its voltage should be three sevenths of the primary voltage.

Finally check the secondary and this is the most important one (although if *any* winding is wrong it will stop the CDI from working). Earth the outer end of the secondary and monitor the inner end. Similarly the two voltages should be in phase and in this case the voltages should be in the ratio of 45/7. If this is okay then the secondary can be terminated on the former pins. The inner goes to the third pin from the left when you hold the coil with the pins towards you. It's the end that connects to the node of C2 and R4 so check it against the layout to make sure you've got the right pin. The other end of the secondary goes to the pin next to it on the other side of the centre gap — refer to the layout again. This completes the coil and it's ready to go into the board.

This brings us to L2. This is a toroidal coil wound on a Neosid 28-013-36/F9 core. The only one I could get was uncoated bare ferrite which was a damn nuisance as the ferrite is conductive. If you can get the varnished ones it'll save you a lot of fiddling around. I had to give the core several coats of varnish myself before I could use it.

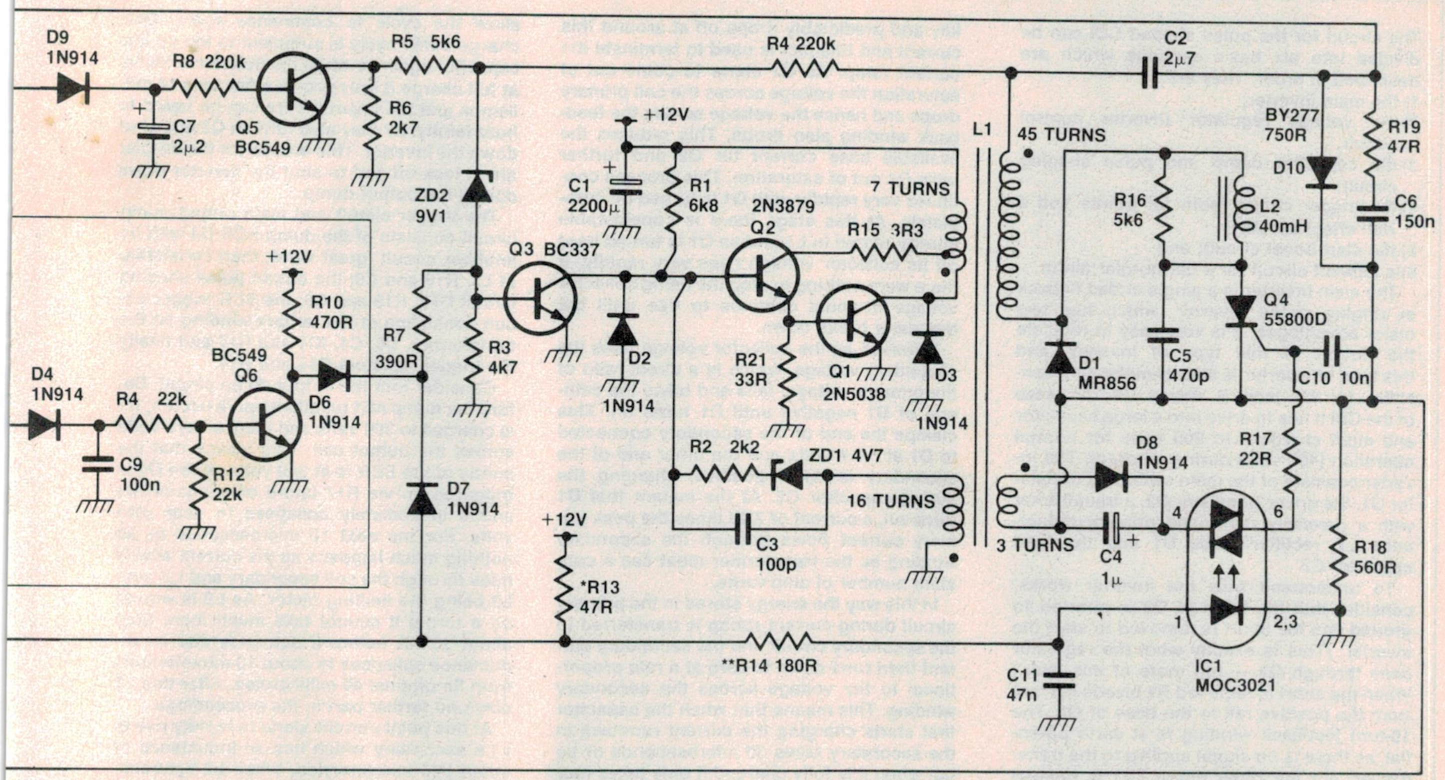
I used the ubiquitous Richard's pressure pack clear acrylic spray. It seemed to work just fine. I held the core on a pair of tweezers as it's *very* important that the corners of the core be completely covered. After it's dried it has to be wound (boring!). The winding is about 60 turns of 0.2 mm wire which needs 2.2 metres of wire. Each turn must be carefully placed next to the turn before with no space left between the turns, but once again no turn lying over the turn before. Wrap each turn over the core tightly. It's easiest to start the winding in the centre so you don't have to thread so much wire through the core. If you can sucker someone into it, it helps to have a second person take the end of the wire after you thread it through the core and pull it away from you while you guide it through the core then hand the end back to you when you're ready.

When all 60 turns are wound on you should have a few millimetres of space be- ▶



PARTS LIST — ETI-342

Resistors	all ½ W 5% unless noted
R1	6k8
R2	2k2
R3	4k7
R4, R8	220k
R5, R16	5k6
R6	2k7
R7	390R
R9, R20	100R
R13	100R
R13	See text
R14	See text
R15	3R3 2W wirewound
R17	22R
R18	460R
R19	47R 2W wirewound
Inductors	
L1	Wound on TDK core type PQ32/20 H7C1 ferrite (from GEC — see construction)
L2	Wound on Neosid toroid type 28-013-36/F9 (preferably coated — see construction)
Capacitors	
C1	2200µ/25 VW electro (see construction)
C2	2µ7 400 V foil film (see construction)
C3	100p/100 V ceramic plate
C4	1µ/25VW electro (rad)
C5	470p/500 V 10% cer. plate
C6	150n/250 Vac metal foil (see text)
C7	2µ2/25 VW electro (rad)
C10	10n/63 V met. poly.
C11	47n/63 V met. poly.

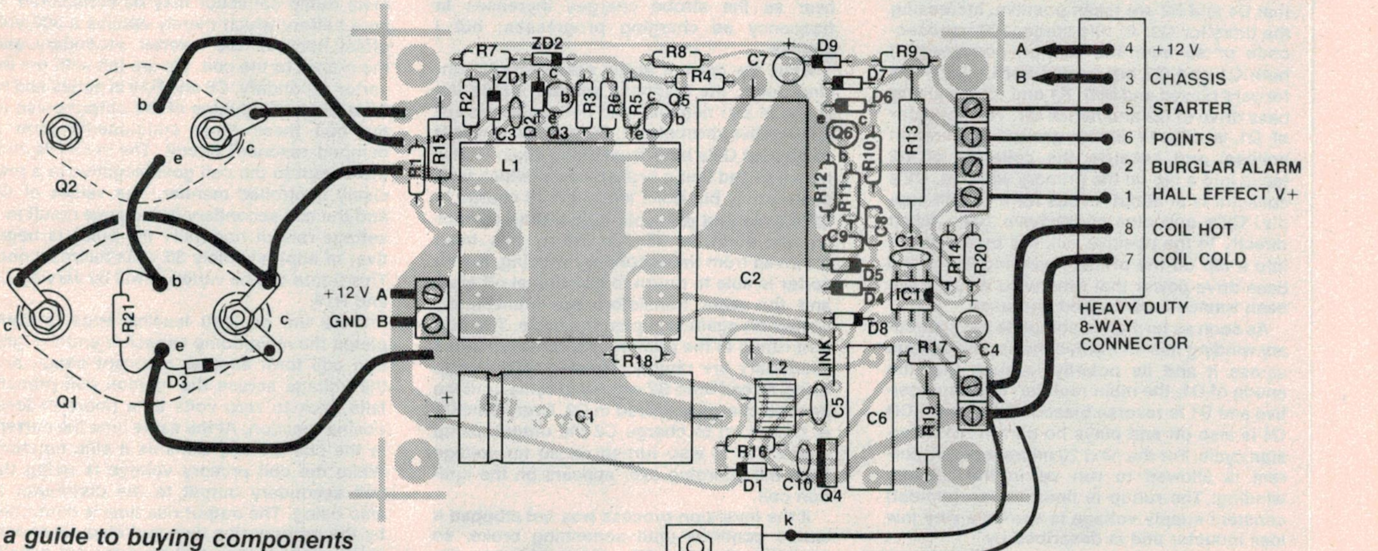


FOR HALL EFFECT SENSOR:
*R13=300R/1W
**R14=22R

NOTES & ERRATA

Feb. '85, CDI p.63: The circuit diagram for this project shown last month had two errors: R8 should have been 220k not 220R and Q4 should have been listed as 55800D not S5800D.

Q1,Q2 REAR VIEW



For a guide to buying components and kits see SHOP AROUND this issue.

Semiconductors
- D1 .... MR856 (Motorola)
- D2, 3, 7, 8, 9 .... 1N914 or similar
- ZD1 .... BZX79/C9V1 zener
- D10 .... BY277/750R or equiv.
- ZD2 .... BZX79 C4V7 zener
- Q1 .... 2N5038
- Q2 .... 2N3879
- Q3 .... BC337
- Q4 .... 55800D SCR (RCA) (see text)
- Q5 .... BC549 or sim.
- IC1 .... MOC3021 (Motorola)

Miscellaneous

ETI-342 pc board; diecast aluminium box 120 x 95 x 56 mm; heavy-duty 8-way connectors — panel socket, 2 x cord-type plugs; nuts, bolts, pcb mounting spacers etc.

Optional (burglar alarm option)
- R10 .... 470R 0.4 W 5%
- R11, 12 .... 22k 0.4W 5%
- C8, 9 .... 100n/63 V met. poly
- D4, D5, D6 .... 1N914 or similar
- Q6 .... BC549 or similar

Price estimate: $45

The circuit for the pulse shaped CDI can be divided into six basic sections which are described in order. They are:
1) the main inverter;
2) the voltage regulator inverter control circuit;
3) the capacitor dump and pulse shaping circuit;
4) the trigger circuit (both for points and a Hall effect sensor);
5) the start boost circuit; and
6) a lock-off circuit for a car burglar alarm.

The main inverter is a single ended flyback or ringing choke inverter, which has two major advantages: it is very easy to regulate the output of this type of inverter, and this type of inverter is also completely insensitive to the load it drives. In the case of the CDI it has to drive into a large capacitor and must charge it to 300 volts for normal operation (400 volts during starting). The inverter consists of the main switching transistor Q1, the driver transistor Q2, a transformer with a precisely controlled primary inductance L1, rectifier diode D1 and the load capacitor C2.

To understand how the inverter works, consider that the base of Q2 is shorted to ground and the short is removed to start the inverter. (This is exactly what the regulator does through Q3 — but more of this later.) When the short is removed R1 bleeds current from the positive rail to the base of Q2. The 16-turn feedback winding is at earth potential, as there is no signal applied to the transformer, but the zener diode ZD1 is reverse biased and will allow the base of Q2 to go up to 4.7 volts before it breaks down.

When the base of Q2 reaches about 0.8 volts, Q2 starts to turn on and applies the full supply voltage across the primary winding. The polarity of the feedback winding is such that D4 and R2 are taken positive, increasing the drive for Q2. At this stage (100 nanoseconds or so after the turn-on commenced) both Q1 and Q2 are turned hard on. ZD1 is forward biased and both R1 and R2 are giving base drive to Q2 and hence Q1. The collector of Q1 is 100 mV above ground (saturation voltage) and because the collector of Q2 feeds into a tap on the primary winding, Q2's collector is at about 4 volts for a 13 volt supply. Q2's collector could have been taken directly to the positive rail, but by feeding it into a tap on the primary winding 2/3 of the base drive power that otherwise would have been wasted is recovered and used.

As soon as turn-on is complete the secondary winding has 45/7 times the supply voltage across it and its polarity is such that the anode of D1, the main rectifier, is taken positive and D1 is reverse biased. The dump SCR Q4 is also off and plays no part in the inversion cycle. For the next 20 microseconds current is allowed to run up in the primary winding. The runup is linear as an (almost) constant supply voltage is across a *very* low loss inductor and is described by

$$I_{pk} = \frac{V_{cc}\, t}{L}$$

where I_{pk} is the maximum current,
V_{cc} is the supply voltage,
t is the runup time and
L is the inductance.

After 20 microseconds the current has reached about 20 amps and R1 and R2 aren't able to supply sufficient base current to hold Q2 and Q1 in saturation. The beta of Q1 rapidly and predictably drops off at around this current and this fact is used to terminate the current ramp. As Q1 starts to come out of saturation the voltage across the coil primary drops and hence the voltage across the feedback winding also drops. This reduces the available base current for Q2 and further pulls Q1 out of saturation. This process continues very rapidly until Q1 is turned off completely. At this stage there is considerable energy stored in L1 and as Q1 is turned hard off its collector voltage rises very rapidly. If there were nothing to stop the rising collector voltage it would continue to rise until the transistor broke down.

However, as the collector voltage rises the secondary voltage, which is a direct ratio of the primary voltage, falls and takes the cathode of D1 negative until D1 turns on. This clamps the end of the secondary connected to D1 at −0.7 volts and the other end of the secondary is taken positive, charging the output capacitor C2. At the instant that D1 turns on, a current of 7/45 times the peak primary current flows through the secondary winding as the transformer must see a constant number of amp turns.

In this way the energy stored in the primary circuit during current runup is transferred to the secondary circuit and the secondary current then runs down to zero at a rate proportional to the voltage across the secondary winding. This means that when the capacitor first starts charging the current rundown in the secondary takes 30 microseconds or so but when it is fully charged it only takes four or five microseconds. This means that the frequency of oscillation of the inverter increases as the capacitor charges.

As a matter of casual interest exactly this sort of circuit is used in photographic flashguns and that is why the faint whistle you hear as the strobe charges increases in frequency as charging progresses; but I digress.

While the current in the secondary is running down, the feedback winding holds the anode of ZD1 negative and hence the base of Q2 negative through R2. D2 acts as a clamp to prevent Q2's base from being taken too far negative and being broken down (which isn't destructive, but does leave stored charge in Q2's base and prevents it operating correctly). As soon as all the energy has been removed from the secondary winding, the inverter is able to return to its original off state and the main transistors are immediately turned on again to repeat the cycle. The current runup in the primary and rundown in the secondary are rapidly repeated with charge being forced onto C2 with each cycle until the desired charge is stored in C2. Every time D1 is turned on to charge C2 the output clamp diode D10 is also turned on so no voltage from the charging ever appears on the ignition coil.

If the inversion process was not stopped it would continue until something broke, so after the capacitor C2 reaches 300 volts the inverter is shut off.

Inverter control is performed by resistors R4, R5, R6, zener diode ZD2 and transistor Q3. R4 forms a potential divider with R5 and R6 to divide the output voltage down to about 10 volts at full charge. At this voltage ZD2 starts to break down and provide base current for Q3. When Q3 starts to turn on, it robs the main inverter of base drive and prevents oscillation. Thus the inverter charges C2 until ZD2's zener voltage is reached, then it steps until R4 bleeds enough charge from C2 to allow the cycle to commence again. One charge-dump cycle is sufficient to top up the capacitor again so when the inverter is idling at full charge it only grows a few tens of millamps and the inverter core can be heard to buzz faintly. R7 may also turn on Q3 and shut down the inverter. This is used for the burglar alarm lock-off and to shut the inverter down during the output dump.

The trigger circuit and main output dump circuit consists of the dump SCR Q4 with its snubber circuit (great word, that) consisting of L2, R16 and C5; the output pulse shaping circuit D10, R19 and C6; the SCR trigger circuit consisting of the tertiary winding on the transformer, D8, C4, IC1 and R17 and finally the trigger resistors R13 and R14.

Consider first the output dump circuit. Before the dump and resultant spark occurs, C2 is charged to 300 volts and there is zero volts across the output coil. This means that the anode of the SCR is at 300 volts. When Q4 is triggered on via R17 (more of this later) its anode immediately collapses to near zero volts. For the next 10 microseconds or so nothing much happens as the current slowly rises through the coil secondary and L2, with L2 being the limiting factor. As L2 is wound on a toroid it cannot take much more than about 50 mA before it saturates and its inductance collapses to about 10 microhenries from its original 40 millihenries. After this L2 plays no further part in the proceedings.

At this point current starts to rapidly rise in L1's secondary which has an inductance of about 500 microhenries. When L2 saturates and drops from sight the SCR end of L1's secondary is also clamped to ground. Now the output to the coil also starts to go negative and D10 is turned off. The ignition coil itself is of such a large inductance that it can be effectively ignored at this stage. Also the main dump capacitor may be considered to be a battery which merely applies a 300 volt offset between the inverter secondary and the output to the coil. We are left with the invertor secondary, C6 and R19 in series and to form the leading edge of the output pulse to the coil these three components form a damped resonant circuit. The result is that the output to the coil goes negative in a precisely controlled manner. The values of C6 and the coil secondary inductance result in a voltage rate of rise (fall? the pulse is negative) of approximately 30 volts/microsecond. This figure can be varied at will by varying C6 and R19.

Once the damped leading edge is completed the main dump capacitor and the ignition coil form another resonant circuit and the voltage across the ignition coil primary falls back to zero volts as a (more or less) cosine function. At the same time the current in the coil primary rises as a sine function. While the coil primary voltage is rising the coil secondary output to the distributor is also rising. The output rise time is controlled by the primary rise time and also secondary stray capacitances and so does not exactly follow the primary. It rises until the plug gap breaks down, when the voltage almost instantly collapses to about 1000 volts. It is this extremely fast voltage collapse that causes most of the radio interference. Both the coil primary and secondary voltages are shown in Figure 7(b). When the plug gap breaks down it reflects a changed load into the primary side and effectively reduces the primary inductance which is visible in the photo.

After plug breakdown the current in both the primary and secondary continues to rise

until the voltage across the coil primary reaches zero when the current in both the primary and secondary is at a maximum. As the coil primary is resonating with C2 the voltage across the coil attempts to change polarity but the clamp diode D10 prevents this and when the first quarter cycle of the resonance is completed D10 shorts out the coil primary. At this stage *all* the energy stored in C2 has been transferred to the coil and D10 makes sure that it stays there.

At this stage the CDI apart from D10 has completed its job. The current trapped in the coil decays away to zero with most of the energy going into the spark gap in the secondary circuit. The primary winding resistance and diode voltage drop also absorb some of the energy, but most of it goes where it's wanted. The overall effect of D10 is to lengthen the spark, exactly what is needed with lean and turbulent mixtures in modern engines. The turbulence in the combustion chamber extinguishes the arc then the coil secondary voltage immediately rises and strikes a new arc as an inductor carrying current will not allow itself to be open circuited (or not without a fight).

The inductor L2, resistor R16 and capacitor C5 are there to protect the SCR from the very rapid changing voltages that appear on the inverter secondary when the inverter is charging. When C2 is nearly charged the side of the inverter connected to it is held at a steady 300 volts. This means that when Q1 is on, the cathode of D1 is at 300 + 45/7 V_{cc}. When Q1 turns off, the cathode of D1 immediately goes to slightly below ground and when all the energy is removed from the inverter coil the voltage equally rapidly goes back to 300 + 45/7 V_{cc} (see Figure 7[c]).

All SCR's have a maximum rate of rise specified for off state voltage and if this rate of rise is exceeded then the SCR wil turn on. This is because there are internal capacitances within the bulk of the SCR that allow current to flow and part of this current flows in the gate circuit of the SCR. As the SCR cannot distinguish between these capacitive currents and true trigger currents, the SCR will turn on. C10 is placed across the gate of the SCR to try to help but its effectiveness is limited by bulk effects within the SCR. The SCR chosen has a very high dV/dt rating (it's chosen for exactly that) but some external control is still needed. This is what the LCR network is for.

When the SCR is off only a very small current flows through L2 and R16; just enough to charge C5. R16 critically damps the resonance of L2 and C5 so no ringing occurs and the resultant waveform is shown in Figure 7(c) along with the coil secondary voltage before dV/dt limiting. You can see the rate of change of voltage is kept down to 100 V/microsecond — exactly the required maximum. As already discussed when the SCR is triggered on, L2 very quickly has too much current flowing through it and saturates.

The trigger circuit for the SCR derives its power from a tertiary winding on the inverter coil. This is because the inverter is capable of operating down to a supply voltage of 2 volts and this is not sufficient to trigger the SCR reliably. When the dump capacitor is fully charged, D8 charges C4 to about 20 volts. It's one of the nice features that when one output of a flyback inverter is regulated, all the other outputs are also regulated. This means that the trigger current for the SCR is always set at the optimum 1 amp peak.

The current is switched to the SCR from the capacitor via the optocoupler IC1. Since an optocoupler is used the whole secondary/dump circuit can be and is floated from the main ground of the system. This is done so that if the full supply voltage is applied to the output to the coil, D10 isn't destroyed. R18 connects the output ground to the main ground so the regulation network has a reference voltage to work to.

As the CDI may be operated from either the conventional points *or* a Hall effect sensor two options exist. For points, R13 is a 47 ohm 5 watt resistor and R14 is a 180 ohm resistor. When the points are closed the optocoupler input is off and D7 has no bias across it. Thus the inverter is enabled to charge C2 and no trigger current is released to the SCR. When the points open D7 holds the inverter off and at the same time the input LED of IC1 is turned on. This triggers the triac side of the optocoupler and discharges C4 into the SCR gate. From here on until the points stay open long enough to recharge C2 and hence C4, no trigger current is available so contact bounce is eliminated.

For the Hall effect option R13 is changed to a 300 ohm 1 watt resistor and R14 becomes a 22 ohm resistor. The Siemens HKZ101 sensor can only switch 40 mA and all of this is needed to trigger the optocoupler; hence R14 is small. As a matter of interest the points option will operate down to 2 volts supply but the Hall effect option only works down to 4.5 volts due to limitations in the sensor itself.

When starting the engine it's nice to be able to increase the spark energy to give more reliable results. The only thing controlling the output voltage is the regulator circuit already discussed. A start signal is taken into the CDI and during engine cranking charges C7 to the supply rail through D9 and R9. This turns on transistor Q5 and shorts out part of the regulator potential divider. Thus the output must rise to 400 volts or more before the inverter is shut down. C7 ensures that the boosted voltage is maintained for a few seconds after the engine catches, before slowly decaying back to the operating voltage.

The final refinement in the circuit is a lock-off circuit to be controlled by a car burglar alarm. Since simply having a control line that had to be connected to ground or V_{cc} wouldn't slow up a competent thief, this circuit requires an ac signal to enable the inverter. The signal is capacitively coupled in via C8 and then rectified by diodes D4 and D5 to provide a dc signal to turn on Q6. When Q6 is on, D6 is reverse biased and enables the inverter but if Q6 is off then R10 and D6 hold the inverter off.

If you don't want the burglar alarm feature, the best approach is to simply leave out D6, R10, Q6 and all of the other parts connected to Q6's base. The burglar alarm input (2) can then be ignored.

tween the two ends of the winding. This is deliberate as each winding has only a few volts difference from the turn next to it but the two ends have the full 400 volts or so across them. When the core is completely wound give it a few more coats of the acrylic spray to insulate, hold down the winding and L2's complete.

Now comes the easy bit — assembly of the board. All the components are perfectly straightforward. Make absolutely sure that all the diodes go in the right way and also the electrolytic capacitors. C1, the main supply capacitor is particularly critical as it sees very high ripple currents when the inverter is running at full power. Your el-skungo cheapy capacitors probably aren't good enough and certainly aren't good enough if you insist on mounting the CDI under the bonnet of the car. I used a Rifa PEG 123 capacitor which is just okay but if it's to go in hot places a Rifa PEG 124 would be better. Whatever you use try to be sure it'll tolerate intermittent ripple currents of about 5 amps at 25 kHz.

The big electrolytic needs a little care in mounting also. Cars are prone to high vibration and heavy components need more than the support given by the two leads. When commercial equipment is tested one of its tests is to place it on a vibration table and apply a swept sine wave to the table while mounting the device under test in various orientations. When mechanical resonances occur it really is dramatic. What appears to be a rigidly mounted component suddenly starts to move tens of millimetres and will easily break the leads.

In the case of the big electrolytic this is easily fixed by using double sided foam sticky tape that can be bought from any hardware store. I bought mine from BBC and it was called "Permastik Double Mounts". Cut a piece about 10 mm x 40 mm and stick it to the side of the capacitor. Then mount the capacitor on the board so the foam is sandwiched between the capacitor and the board. This will nicely damp out any mechanical resonance.

The toroidal inductor L2 *must absolutely* be stuck down to the board. I used generous quantities of silicone glue (e.g: "Silastic"). The same can be said for the two small electrolytics C4 and C7. As a nicety I used screw terminals for all the leads that go to the outside world from the CDI and the board layout leaves space for them. You need two 2-way terminals (Jaycar #HM3205) and one 4-way terminal (Jaycar #HM3207).

The board is layed out so the leads that connect the inverter to its transistors can be made as short as possible and the leads form a sort of hinge to allow both sides of the board to be worked on. This means that the two leads from the output to the coil to D10 should be looped as shown in the photograph on page 73. The collector of Q1 should be connected to the board with enormously thick wire — here more is definitely better. Also if you look carefully at the picture you'll see that there is a lead connecting the two mounting screws of Q1. This is because the screws have a noticeable resistance (they're plated brass).

The board is mounted on four half-inch (oops! sorry 12.7 mm) spacers and in the prototype I didn't bother to earth the box at all. After you've connected all the wires between the board and transistors and diode on the heatsink, the board can be mounted on its spacers and the beast is almost ready to stoke up.

The one thing the CDI doesn't particularly like driving into is an open circuit. It doesn't damage anything but after triggering things tend to stay at high voltages for a long time. Better to go and pull the coil out of your car for testing. Connect the '+' terminal of the coil to the 'hot' output, the '−' to the earthy output and a suitable power ▶

supply to the input. If you intend to use the burglar alarm option and have assembled it up it'll be necessary to temporarily short Q6's collector to ground or nothing will work. Alternatively you could put a high level audio tone of about 5 kHz into the alarm lock-off input and check that the lock-off works okay. (Q6's collector goes to ground.)

With the points input open circuit the inverter is shut off so the CDI should only draw a tiny amount of current. However when the points input is taken to ground the inverter recharges C2 and for a few milliseconds draws 5 or 6 amps and after that draws very little. R13 is only 47 ohms though and draws about a quarter amp (to keep the points clean). After charging, the inverter cycles every 25 milliseconds or so and if you listen carefully you should be able to hear a faint buzz. If you measure the voltage across C2 you should get 300 volts dc. Be careful with the probes as if you short the dump capacitor to anything else it makes for a loud bang and flash. The next test is to take the 'start' input to the positive rail. The buzz from the inverter should increase in frequency and the voltage across C2 should rise to 400 volts. Finally open circuit the points input and the CDI should trigger.

To make life a little easier it's a good idea to arrange a spark gap for the coil secondary about 5 mm long. When you're doing this, *make sure the CDI is disconnected from the power.* Take about 400 mm of the wire you used to wind your inverter coil secondary and crumple it into a ball with about 50 mm sticking out of it. Stuff the ball into the coil output and bend the wire so it points at the earthy primary terminal. Then when the CDI is running a nice fat spark should jump across the gap you've made.

If you've used the Hall effect sensor option then connect the sensor up with the positive lead (the red one) to R20 and the negative one (the black one) to ground. For this test R13 should be 300 ohms and R14 22 ohms. Connect the sensor output to the points input and test the inverter as before except that the CDI is triggered by flicking a screwdriver blade through the slot in the sensor.

Finally you can vary the supply voltage to the CDI and verify that it still works for the full range. The prototype worked just fine from 25 volts in (the maximum allowed for C1) to just on 2 volts in with the points option. For the Hall effect option it wouldn't trigger reliably for less than 4 volts but this was expected.

If all is well you can wire up the connector in the side of the box and install the CDI in your car. I used an 8-way connector and arranged things so that if the CDI failed the cable connecting the CDI to the car could be removed from the CDI and a jumper plug inserted in its place. As the CDI does not mind having capacitance across its output I used RG58C/U coaxial cable to connect the CDI to the coil. The outer was connected to the earthy side of the output and the inner conductor to the hot side. This screened the output from the radio as the CDI was mounted under the dash. Since long cables can be used with this CDI there is absolutely no reason to put the CDI under the bonnet so have some sympathy for the electronics and put it somewhere cool. At a pinch it could even be placed in the boot so long as you used very thick power leads.

After installing the CDI there's no reason to do anything with the plug gaps and in fact it's a good idea not to. In the event that the CDI should fail you want to be able to quickly change back to the old system. It may seem a little negative to talk about failures but they do happen. Equipment built by home hobbyists is perhaps a little more prone to failure than commercial equipment mostly because the hobbyist doesn't have access to fancy test equipment and he has little control over the quality of the components he buys.

I can report that the CDI when installed in my V8 powered car gave absolutely no trouble with cross firing and gave all the improvements that electronic ignition is supposed to. I had some time ago changed the carbon filled resistive leads for copper ones so this change wasn't necessary in my case but if you still have the resistive leads it'd be a good idea to change to the metal filled ones. As you can see from the picture of the pulse shaped CDI secondary voltage and current (Figure 7[d]) a secondary current of about 70 mA flows and, as the typical resistive lead resistance is about 20 k a voltage drop of about 1.4 kV is to be expected. You may or may not choose to accept this loss but the CDI will work just as well in either case. The spark duration will be reduced if the resistive leads are left in. ●

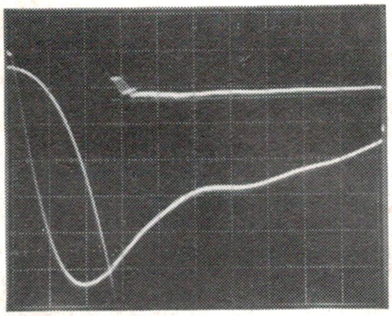


Figure 7(b). Coil primary (lower) and secondary voltage for the new CDI. Time 10 µs/div, prim 50 V/div, sec 2 kV/div.

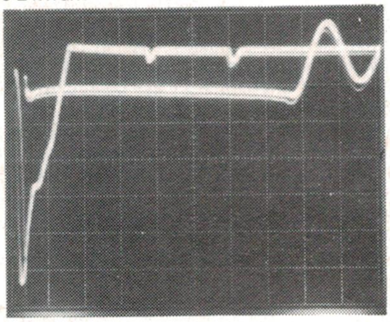


Figure 7(c). As above, but with 100 µs/div to show arc duration.

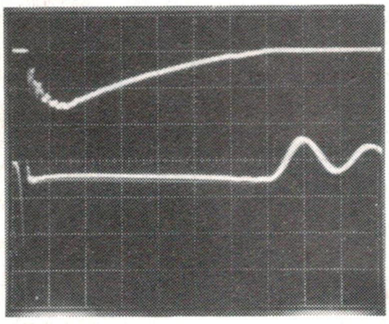
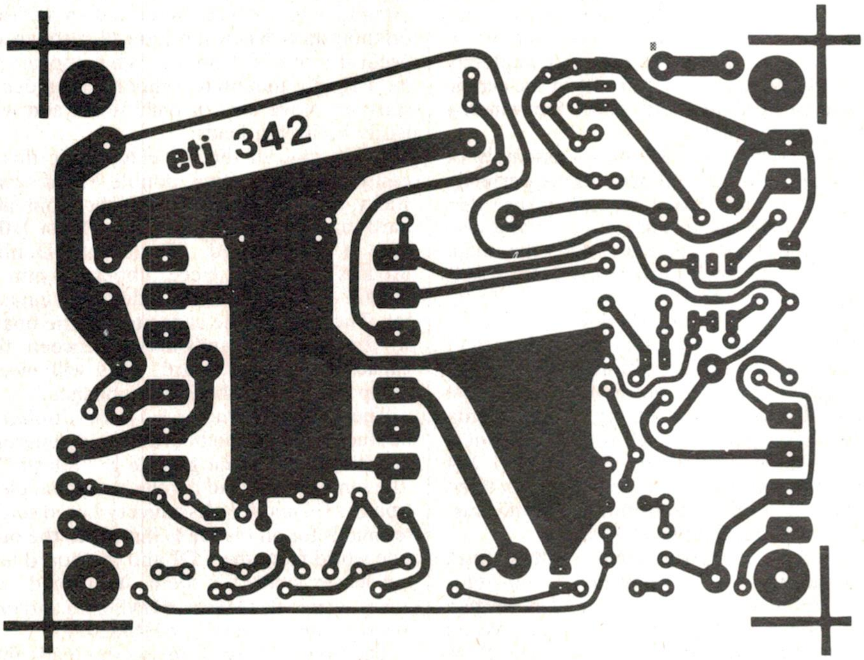


Figure 7(d). Coil secondary current (top, 50 mA/div) and voltage (bottom, 2 kV/div).



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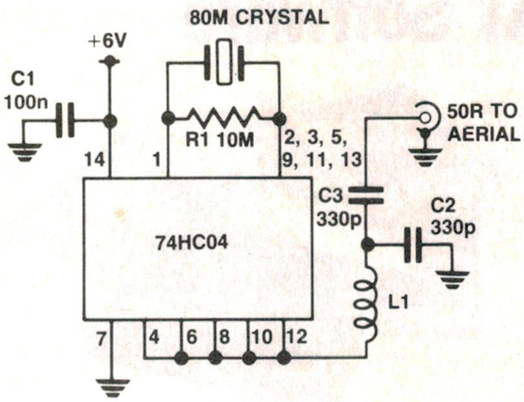

L1 = 10 turns wound on 50 mm of 10 mm ferrite rod. The rod should be loose enough to allow for initial adjustment.

CMOS 80M transmitter

John Rickard of Heathmont, Vic, has designed this simple circuit for use as a transmitter broadcasting on 80M. It consists of a CMOS inverter wired as a crystal oscillator.

The output is fed to the 50 ohm load by the LC matching circuit which functions to reduce harmonics. The output power is 150 mW or so with a 6 V supply rising to over 200 mW with 7 V in. Over 500 mW has been obtained from the circuit, but this was achieved with a 12 V supply, and considerably exceeds manufacturers specifications.

The output circuit is brought to resonance by adjusting the position of the ferrite rod in the coil while observing the supply current. A peak in the current coincides with maximum RF output. Keying the transmitter is easily achieved by interrupting the supply.

The circuit could easily be adapted to other frequencies by suitable scaling of the LC output circuit, and substituting a suitable crystal.

'IDEA OF THE MONTH' CONTEST

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Cut and send to: **Scope/ETI 'Idea of the Month' Contest, ETI Magazine, P.O. Box 227, Waterloo NSW 2017.**

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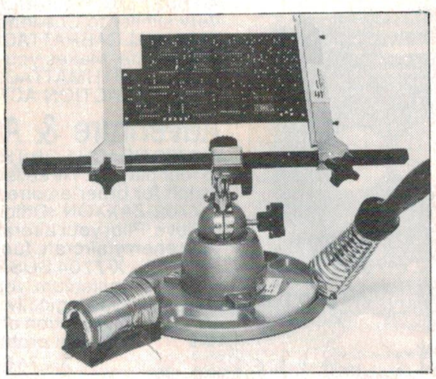


PRIZE WORTH $123!

Scope pc board Work Centre

Scope Laboratories, which manufactures and distributes soldering irons and accessory tools, is sponsoring this contest with a prize given away every month for the best item submitted for publication in the 'Ideas for Experimenters' column — one of the most consistently popular features in ETI Magazine. Each month we will be giving away a pc board Work Centre consisting of the Model 315 adjustable pc board holder with capacity to accept 300 mm boards, Model 300 180° swivel and lock base which can be attached to the Model 312 tray base with wet sponge receptacle, Model 371 solder spool holder and Model STS 3 soldering iron safety stand. Please note prize does not include solder or scope TC60 temperature controlled iron shown above. The prize is worth $123!

Selections will be made at the sole discretion of the editorial staff of ETI Magazine. Apart from the prize, each winner will be paid $10 for the item published. You must submit original ideas of circuits which have not previously been published. You may send as many entries as you wish.

RULES

This contest is open to all persons normally resident in Australia, with the exception of members of the staff of Scope Laboratories, The Federal Publishing Company Pty Limited, ESN, The Litho Centre and/or associated companies.

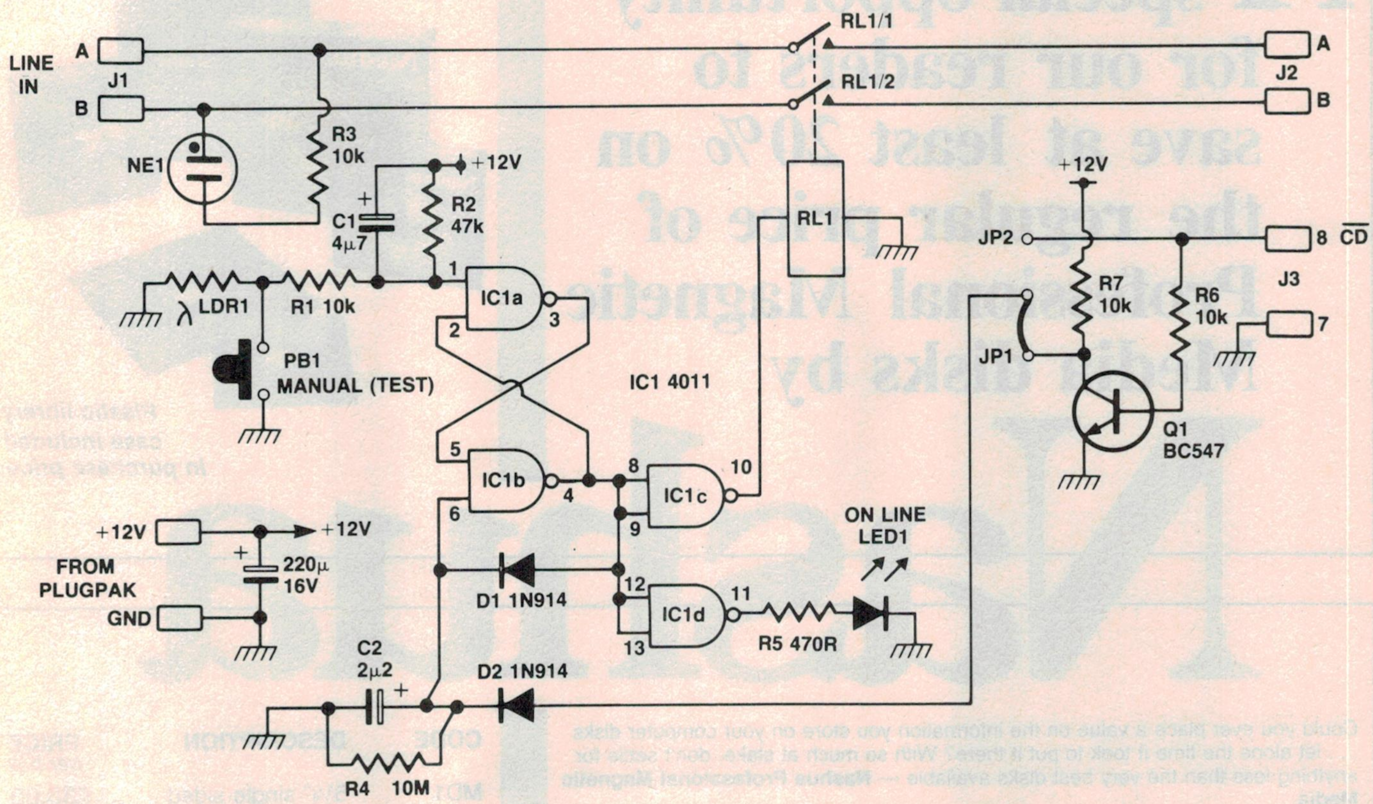
Closing date for each issue is the last day of the month. Entries received within seven days of that date will be accepted if postmarked prior to and including the date of the last day of the month.

The winning entry will be judged by the Editor of ETI Magazine, whose decision will be final. No correspondence can be entered into regarding the decision.

The winner will be advised by telegram the same day the result is declared. The name of the winner, together with the winning idea, will be published in the next possible issue of ETI Magazine.

Contestants must enter their names and addresses where indicated on each entry form. Photostats or clearly written copies will be accepted but if sending copies you must cut out and include with each entry the month and page number from the bottom of the page of the contest. In other words, you can send in multiple entries but you will need extra copies of the magazine so that you send an original page number with each entry.

This contest is invalid in states where local laws prohibit entries. Entrants must sign the declaration on the coupon that they have read the above rules and agree to abide by their conditions.



An auto answer facility

G. Dicker Coromandel Valley SA

Over the last few years a number of modems have appeared on the open market at very reasonable prices. However, most lack the auto answer facilities of higher priced models. Even if you are prepared to pay the price for an auto answer facility they often require the host system to provide software to control it.

This circuit meets both these objections. It is cheap and it requires no controlling software.

The adaptor detects Telecom ring tone through connector J1. Ring tone consists of a 15 Hz signal at approximately 150 mV p-p. This turns on NE1, a neon light, which is aimed at a light dependent resistor (LDR). Power to the LDR is provided via an RC network that has a time constant long enough to prevent false triggering due to noise on the line.

When the neon lights, pin 1 of IC1a will be driven low. Since IC1a and 1b are connected as a latch the circuit will switch on with pin 4 latched low. This is inverted by IC1c and used to drive RL1, a miniature relay, which connects the modem to the line.

Q1 is used to dectect whether carrier is present by monitoring the CD output of the modem. Strapping at JP1 or JP2 allows the user to select for either a positive or negative carrier detect (CD) signal. In either event the output from the CD circuit is used to charge the RC network made up of C2 and R4. This circuit has a time constant of about 15 seconds. If carrier is not detected within this time pin 6 of IC1b will go low causing pin 4 to toggle and the modem to drop out.

IC1d is used to drive LED1 which can be used to monitor the status of the circuit. A manual test button is also provided in PB1.

In operation the author used the system to drive an opto isolated mains supply to provide power to the CPU. This meant that the host system could be shut down completely. When an incoming call was received the entire system could be started up.

Construction is fairly straightforward, except that it is important that the neon light and LDR be isolated from ambient light. The author achieved this by using heat shrink to hold the two elements face to face.

NOTES & ERRATA

In our December 84 issue we published a circuit for a darkroom timer as the idea of the month. The author, Mr H. Nacinovich, has written to us with regard to a problem that showed up after the unit had been working for a couple of months, The failure was caused by IC2, a 74LS90, not giving the necessary clock output. Reason: not enough drive from the 4018. The solution is to tie pin 1 of IC2 to ground via a 1k resistor.

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New personal computer from Sharp

FOLLOWING the release in June last year of its new 16-bit personal computer, Sharp Corporation has announced an upgraded version, the MZ5600, now available on the Australian market.

The new model based on the 8086 chip processing at 8 MHz, is a true 16-bit machine which retains the features of its predecessor, the MZ5500, and incorporates new additional capabilities. The MZ5600 handles complex graphics and data processing, has multi-window facilities allowing text, tables and graphics to be transferred, bit-mapped display, high resolution screen image, optional mouse and hard disk drive.

It also incorporates 640K floppy-disk drives which Sharp says positions the MZ5600 ahead of many competitive models.

MS-DOS is bundled with the system allowing implementation of a wide range of software packages, including the most commonly used word processing, spreadsheet and data base packages.

Available accounting software is sourced from IMS, IAL, BCP, Compact, Padmede, Carpe and Davidson. Vertical market packages encompass real estate, video hire managment, medical, travel, agricultural and public accountants.

Sharp hopes the wide availability of software will be the key to the success of the MZ5600 and that it is indicative of the company's computer products marketing philosophy that "as long as the hardware is consistently reliable, software holds the key to successful sales".

For further information contact **Sharp Corporation. (02)728-9111.**

Arcom Pacific releases new dBase II

SOFTWARE DISTRIBUTOR Arcom Pacific has announced the release of dBase II version 2.43 and dBase II Multi-User for the TurboDOS operating system from publisher Ashton-Tate.

dBase II version 2.43 features file indexing from two to six times faster than previous versions and supports the new IBM PC/AT. With the release of the TurboDOS version of dBASE II Multi-user, Ashton-Tate now supports two multi-user environments, the other being 3COM's EtherSeries local area network (LAN).

dBase II Multi-User for the TurboDOS operating system, versions 1.2 and 1.3, is similar to dBase II Multi-User developed for the IBM PC and compatible computers running on the 3COM EtherSeries LAN. dBase II Multi-User provides all the power of dBase II while allowing several users to simultaneously access shared data files and application programs. It is completely compatible with single user dBase II, allowing transfer of data files with no modification.

Features include record and index locking, file locking within an application program and password security within an application program.

More than 16 machines run TurboDOS, including NorthStar, IMS, and Televideo.

For further information contact **Arcom Pacific, 252 Abbotsford Road, Mayne, Qld 4006. (07)52-9522.**

Awards for 'Computer educator of the year'

NEVILLE WRAN, Premier of NSW, was the guest of honour and awards presenter at the first annual Dick Smith Electronics 'Computer Educator of The Year' awards.

The award was created to highlight the achievements of someone in the education field who has been judged to be outstanding in his/her work to further the use and role of computers for education in Australia. He or she may work in any capacity or at any level, but must essentially be an innovator or a driving force whose efforts are felt beyond his immediate workplace.

The judges included Mr Colin Woodley, of the Independent Schools Association (NSW), Ms Marilyn Cross, Applied Computer Sciences of Chatswood, NSW, Mr Adrian Farrow, publisher 'Computing In Education' magazine and Mr Ike Bain of Dick Smith Electronics.

From the hundreds of entries received from all parts of Australia, Brother Vin Hawley, of St Edmund's School For the Blind and Visually Handicapped in Wahroonga, NSW was selected to receive the trophy and $2000 worth of computer equipment from Dick Smith Electronics.

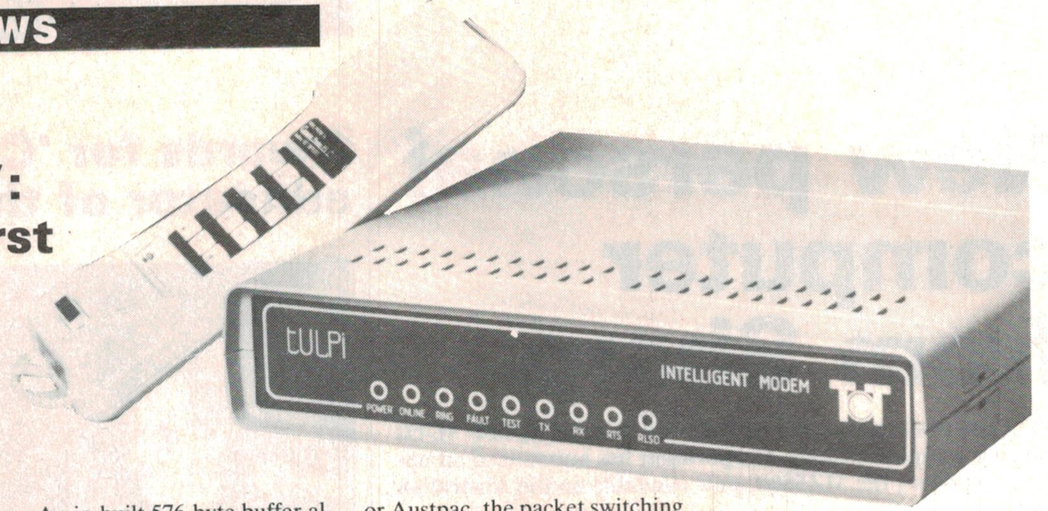
Brother Hawley has introduced 'Braille'-'N-Print' machine to help integrate blind children into regular schools. He has written programs using voice synthesis and large print on six different computers, making it possible for every student at St Edmund's to participate in the 'Computer Awareness' and 'Keyboard Skills' programmes.

Second place went to Mr Murray Luke, Principal of Bemboka Primary School for his work in successful implementation of computers into dozens of schools in the far South East of NSW, assisting and advising them on computer hardware and software purchases.

Mr David Woodrow, Senior Master and Head of the Junior High School at St Peters Lutheran College in Brisbane was the recipient of the third prize. Since 1971 Mr Woodrow has been committed to advancing computers in education not only in Queensland, but on a national basis as well.

The second and third prize winners received a trophy and $500 worth of computer equipment from Dick Smith Electronics.

'Talking stick': Australia's first intelligent modem



A HI-TECH workshop in Hornsby (NSW) has produced the first Australian designed, fully automatic intelligent modem for the switched network, it claims.

Called "Tulpi" — Aboriginal for talking stick — it is a V21 and V23 direct-connect modem with an integrated telephone handset. Designed by Teletext Communication Technology, the modem supports Bell 103 and 202 transmission modes and is Videotex compatible.

Tulpi has no switches or buttons. All commands are passed to it via the RS 232 port, which allows the modem to be controlled from a terminal or by a software package running in a PC.

An in-built 576-byte buffer allows the modem to operate at different baud rates between the line side (Telecom line) and the user side (RS 232 port).

Mr Terrance James, a director of Teletext Communication Technology, said more than $500 000 had gone into developing the Tulpi modem, of which the Federal Government had contributed a good part.

TCT design engineer Brian Mudditt said the Tulpi's 1200/75 operation was useful when signing into a database like Midas — the gateway to US databases — or Austpac, the packet switching network.

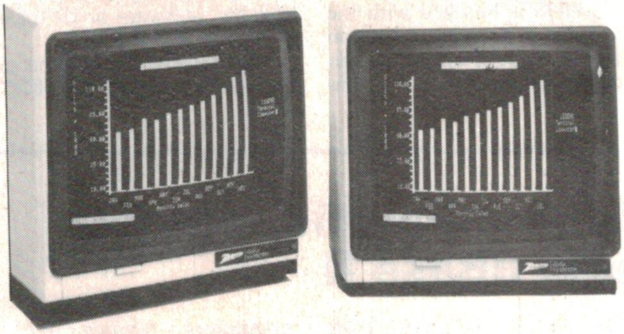
"The 1200/75 allows all information coming on to the VDU at 1200 bits/sec and data in the other direction at 75 bits/sec (7 char/sec), which is faster than the normal operator can type.

"The split board rate facility used where line speeds differ is a big advantage. The buffer enables a screen sending information at 2400 bits/sec to use the 1200/75 facility, storing and forwarding when it is full. No one offers V22 and lower speeds as well, so if the need is for a general purpose modem with auto-dial, Tulpi is ideal because it offers 300 and 1200 half duplex."

ICL has already bought 30 Tulpis and its Traderpoint division is using them to collect account and stock data from its interstate offices.

The Tulpi has non-slip feet for desktop mounting and measures 260 x 250 x 53 mm. It will sell in Australia for about $1150.

For further information contact **Terry James, Teletext Communication Technology. (02)908-1777.**



New IBM compatible monochrome monitor

WARBURTON FRANKI has announced the availability in Australia of a new compact monochrome video monitor, the ZVM-124, designed to be used with IBM or IBM compatible personal computers.

The 12-inch amber video display monitor is housed in a cabinet less than 13 inches wide and is designed to be used with the IBM-PC, XT, 3270 PC and those IBM compatible machines using the Monochrome Display Adaptor Card. Other machines using the Hercules Monochrome Graphics Card or the USI Graphics Card (in the monochrome mode) are also able to use the ZVM-124.

The new monitor utilizes the IBM TTL input giving it increased resolution over composite video units designed for use with the IBM Graphics Colour Card.

The ZVM-124, believed to be the only amber monitor available specifically designed for the IBM-PC, will sell in Australia at a suggested retail price of $359 (incl. tax), including the tilt base option.

For further information contact **Warburton Franki, 7 Birnie Ave, Lidcombe, NSW 2141.**

Blind programming by ear

WHEN BLIND computer programmer, Maryanne Diamond at Victoria's Road Traffic Authority (RTA) asked for help in using new computer display terminals, Computer Power came up with a low cost 'talking' solution.

Computer Power supplied a US developed system The Talking Program and the Votrax Type-N-Talk device to provide spoken output as well as the normal visual display.

Maryanne is now able to hear what she is typing and the computer's response. Previously she was limited to the laborious 'reading' of printed computer output line by line using a hand held scanner which provides Braille style output to a touch plate.

Productivity was low due to the method of typing in unchecked computer programs and relying on subsequent checking and verification using the scanner and Braille device.

With the new Talking Program Maryanne could interact directly with the computer's visual display for programming and word processing. She could also take advantage of screen displayed tutorial material for various software products such as spreadsheets. The program reads and speaks individual characters, a line or a complete screen.

All this gives the visually impaired programmer or computer user much greater flexbility and independence. With the almost universal use of screen based computers and software the visually impaired programmer can bypass painstaking line by line checking of printed output and greatly reduce dependence on assistance from sighted people.

The system set up for Maryanne runs on an IBM PC. With the addition of an Ideacomm emulator card the PC acts as an IBM 3270 terminal for direct connection to the Road Traffic Authority's IBM 4381 mainframe system. This $4.25 million system is being used to produce Victoria's new plastic Driver Licenses.

As a community contribution, Computer Power says it is prepared to import and pass on 'The Talking Program' to other handicapped users at cost, plus provide free consulting service for its use. The package is available currently in two versions and costs approximately $800 for the IBM PC version and $300 for the TRS-80 version.

Further details are available from **Computer Power Melbourne. (03)520-5333.**

Australian communication network for world market

A DIGITAL data communications local area network 'Monet', developed at Monash University, Melbourne, will be manufactured in Australia and marketed internationally under a new agreement signed with Racal Electronics Pty Ltd.

The equipment is designed to provide terminal access to multiple computers as well as computer-to-computer access.

Mr Bob Hammond, Racal Electronics Marketing Manager says that if an organisation wanted to connect 200 terminals for instance then the outlay for networking represents a major investment. "The Monet provides customers with a truly affordable local area network for the first time," he said.

The network has been under development at Monash since 1978, and approximately 20 man years of engineering and software have been invested in it.

The fully matured system is in use on the Monash campus where some 700 terminals talk to 17 mainframes. The other current major users of Monet include Telecom Research Laboratories, the Victorian Harness Racing Board, St Vincents and the Victorian TAB.

Mr Hammond said that production of Monet at Racal's North Ryde, Sydney manufacturing plant was well in hand.

Control information for each device is stored in each node in RAM. The RAM has battery backup to avoid losing this control. While these control tables may be accessed from a privileged port, Netman allows "plain English" set up and control. As well, Netman audits and maintains network statistics.

Technically Monet is buss oriented, 1.5 MBS, transformer coupled using CSMA/CD techniques. Terminal speeds to 19.2K bits are allowed. The cable requirement is shielded dual twisted pair. A number of interfaces are available including RS 232 data only (3 wire), RS 232 (V24/V28) data and modem control, RS 422, 20 mA current loop, X21 and X21 biosynchronous or asynchronous.

Within a few months an X.25 interface will be available and Racal sees this as a very economical solution enabling its electronics funds transfer terminals in retail outlets to be connected to Telecom's packet switched network. As well, a high speed interface between a Monet node and DEC Unibus is to be released shortly. Monet is Telecom Approved.

For further information please contact **Mr Bob Hammond, Marketing Manager, Racal Electronics Pty Ltd. (02)888-6444.**

Micro service adds IBM

RMIT's Australian Microcompture Industry Clearinghouse, AMIC, is to have the support of IBM and shortly, will have a range of IBM's personal computers on permanent display in the Clearinghouse.

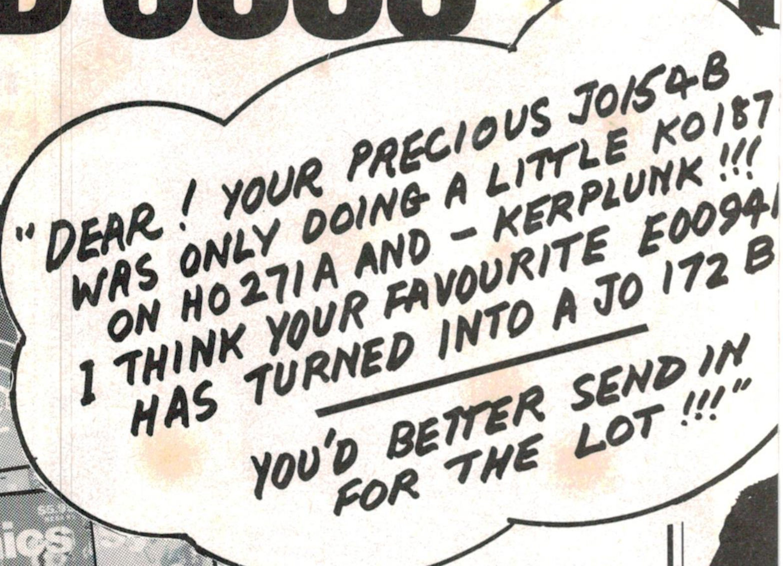
IBM's presence, along with many of the other big names in computing, including Apple, Control Data, Digital, Hewlett-Packard, ICL, Insystems (Cromemco and Stearns), and Tandy, will lend greater credibility to AMIC's claim that it represents the major microcomputer products available on the Australian market.

Started in April last year, AMIC provides information and impartial advice to microcomputer users and future buyers. It does this by allowing the public to test and evaluate the hardware and software it has on display, or by conducting demonstrations.

As well as the international companies which have joined its ranks, AMIC has a display of Australian produced hardware including Labtam, Hartley, Dulmont Magnum, Case and SME Knight. Six further companies have become software members and there are three peripheral manufacturers.

AMIC is located at **Gateway Plaza, 449 Swanston Street, Melbourne.** For further information contact **Peter Wilkinson, (03)348-1775.**

WHAT DID 6809 WH



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ELECTRONIC SYNTHESISER PROJECTS
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For the electronic music enthusiast, an invaluable reference. This book is full of circuits and information on how to build analogue delay lines, sequencers, VCOs, envelope shapers, etc, etc. The author takes a clear and logical approach to the subject that should enable the average enthusiast to understand and build up what appears to be a quite complex instrument.

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It is a solid text for introductory programming courses in Cobol, using a format that is easy to understand, yet comprehensive enough to make supplementary readings unnecessary.

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NEW DOT-MATRIX PRINTER

offers 100 CPS at low cost

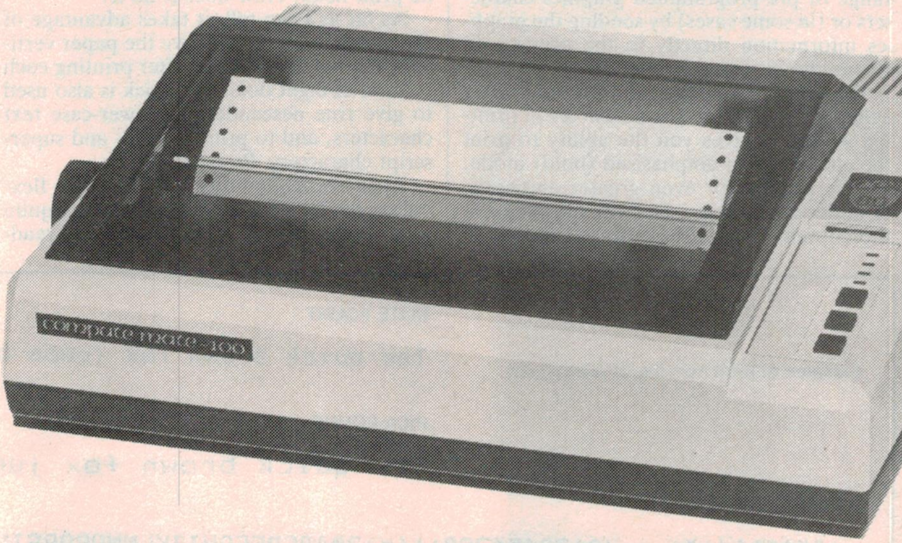
In case you haven't noticed, dot matrix printers have become even more attractive than before. They're now offering faster throughput, better print quality and a wider range of typestyles — all at lower cost. Here's a review of the new CPA-80 printer from Creative Technology International.

Jim Rowe

ALTHOUGH PRINTER technology hasn't developed in quite the same leaps and bounds as computers themselves, many advances have been quietly making themselves apparent. It's only four or five years ago that an 80 cps dot-matrix printer would have cost you around $1000, and those of us who watched the dramatic fall in the price of computers were lamenting the lack of a similar drop in printer prices.

It took a while for printer manufacturers to catch up, but in the last couple of years they've been making up for lost time. The big step forward seemed to come when they realised that instead of using complicated mechanisms and simple electronics, it would be far better to use simple mechanisms with much more 'intelligent' electronics.

A printer then became nothing more than another dedicated microcomputer, operating a few small stepper motors and hammer solenoids and sensing a few microswitches and opto detectors under the control of a program in a ROM chip.



The Japanese manufacturers seemed to grasp this concept first, and they've been leading the field ever since. I suspect this is not just because they made the design breakthrough, but because at the same time they also changed their marketing and selling strategy. Instead of treating printers in the up-until-then traditional way as a prestige, name-branded product line, they started treating them as a commodity: products to be cranked out by the tens of thousands, and sold through all available channels — with whatever labels and cosmetics those channels required.

The floodgates opened a couple of years ago, with the release of a 'family' of 80 cps dot-matrix printers, which have been selling quite well up until now. They're virtually all based on the same mechanism and electronics, with slightly different cases and control buttons. In Australia they go under names like BX-80, BT-80, Fax-80, DP-80 and Super-80 (to name but a few).

Whether or not they all come out of the same factory in Japan, Korea or Taiwan I don't know; although I suspect so. Not that it matters, of course. Generally speaking, they're all excellent little printers — and so much better than previous models in terms of performance/price that where they come from isn't really important. They're compact, reliable and quick, their print quality is good and they cost around $500; roughly half the price of comparable earlier models. What more could you want?

Yes I know, that's a silly question. We want even more features with even lower prices, right?

What's more, we've now got them. The next generation of dot-matrix printers has just arrived, and although they've had surprisingly little fanfare, don't be fooled. They're quite a significant step forward. ▶

PRINTER REVIEW

A few weeks ago I was able to check out one of the new models, made by the Japanese firm Creative Technology International and imported here by Energy Control. It's called the CPA-80, which sounds like one of the now-ubiquitous XX-80 models, but isn't. Perhaps CTI would have done better to call it the CPA-100. I notice that a couple of our other advertisers are now offering what seems to be either an identical or very similar machine, with the name Micron 100.

From the outside, the CPA-100 looks very similar to the XX-80 printer. It's neat and compact, with the usual small array of control buttons and indicator LEDs. But you don't have to look very far to find some differences.

To begin with, it runs at 100 characters/second — 25 per cent faster than the earlier models. Considering that the printer sells for around $380, or about 25 per cent less than the earlier models, that's not bad for starters.

The other main difference is printing flexibility. With the earlier models you generally have a choice of a few different print styles — normal width, double width, compressed width and double width compressed, for example. You also get the ability to print graphics, using either a range of pre-programmed graphics characters or (in some cases) by sending the graphics information directly to the printer pin solenoids (bit-image graphics).

With the CPA-80 this is all carried further again. As well as the normal choice of printing widths, it gives you the ability to print the characters in emphasised (bold) mode, double printed for even greater emphasis, or underlined. It also gives you the choice of three founts: Pica, Elite or italics, plus a full capitals and lower case Greek alphabet. There's also the ability to print both sub- and superscripts, although only in capitals (see, there's something it can't do!). All of these options are selectable under software control, using a system of escape code sequences.

On the graphics side, it gives you a fairly standard set of 103 pre-defined graphics characters. But in addition, if you get the printer fitted with an extra 2K of RAM you can download your own graphics characters into the printer's buffer from a program, and then specify them using character codes.

If this still isn't good enough, you can go to the full bit-image graphics mode. Even here you have some additional flexibility. As well as the normal mode, giving 640 x 8 dots or pixels per printed line, there is a double density mode giving 1280 x 8 pixels. In addition there's a 9-dot-row mode, which can be used in either normal or double-density modes to give either 640 x 9 or 1280 x 9 pixels per line. Again all of these graphics modes are selected using escape code sequences. How's that for less than 400 bucks?

Incidentally the 9-row bit-image graphics mode is very interesting, because the printer appears to have only eight needles in its print head. How does it do it?

As far as I can tell, it takes advantage of the printer's ability to move the paper vertically by one dot position after printing each column of eight dots. This trick is also used to give true descenders on lower-case text characters, and to print the sub- and superscript characters. Pretty nifty!

Apart from all of this mind-boggling flexibility, the CPS-80 also does the basics quite well. Print quality is very crisp and readable, with well-formed characters and clearly defined descenders on lower-case letters. Although the output is clearly still composed of dots, it would nevertheless be entirely acceptable for most correspondence. Hopefully the sample might make this apparent, despite the inevitable degradation in printing.

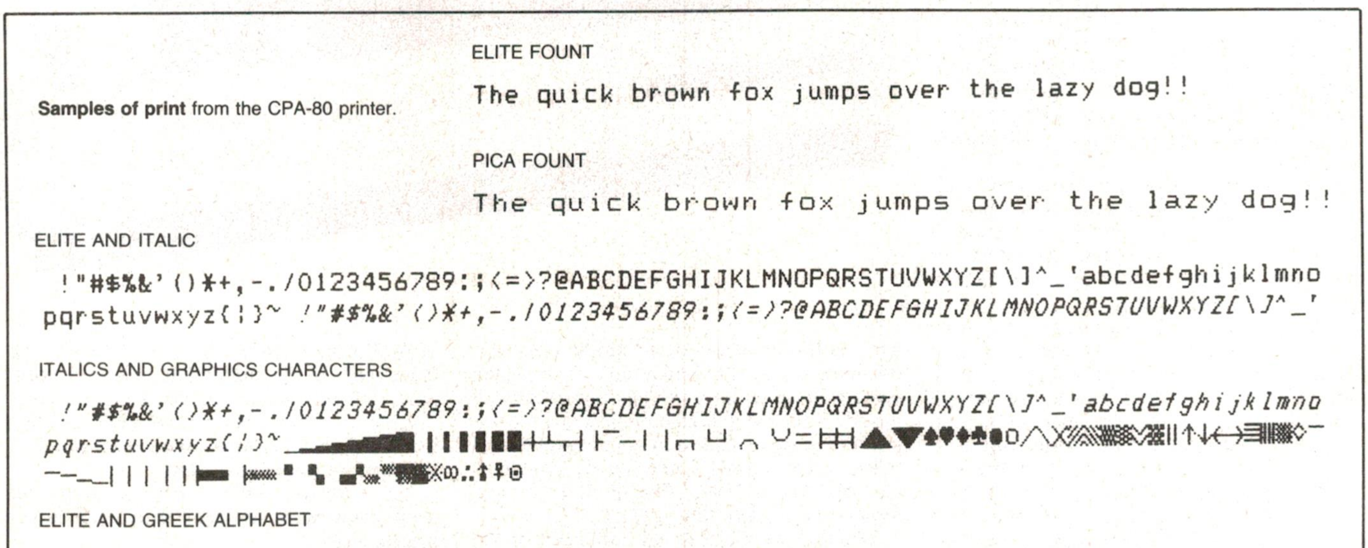
The CPA-80 provides both sprocket and friction feed for the paper, and operates in both uni- and bi-directional logic seeking modes depending upon the type of printing. It is available with either a standard Centronics-type parallel or RS232C serial interface, with only about $20 difference in price (the serial interface costs more).

Incidentally I peeked inside the CPA-80 case, and there's almost nothing inside. Virtually all of the printer electronics (apart from the computer interface) is compressed into about ten ICs — a computer chip, an I/O chip, a ROM, a couple of RAMs and a few housekeeping chips. Despite this seeming innocence, the 'intelligence' of this electronics has allowed the mechanics to be very much simplified, with very few moving parts to cause trouble.

Size of the printer is 384 x 315 x 125 mm, and it weighs approximately 5 kg. Power consumption when printing is 40 watts. The replaceable print head is rated for 30 million characters, and the rest of the printer for 8 million lines. It takes a long, narrow ribbon cartridge, similar to the Epson MX-80 but not quite the same.

The CPA-80 sent for review came from Energy Control Pty Ltd, of PO Box 6502, Goodna, Queensland 4300. Phone (07)288-2455. All in all, I found it most impressive. Printers have finally caught up with computers in terms of benefits versus cost!

By the way, Ken Curry of Energy Control tells me that by the time this review appears, he should have a 15-inch platen version of the printer — for those who need w-i-d-e printout. This model is known as the CPA-136, and should sell for around $420. ●



Samples of print from the CPA-80 printer.

MORE CHATTERBOX APPLICATIONS

Offering economical and elegant solutions to the problems of speech synthesis is one thing, and with handy programs for Microbees and Apples another, but what about the Commodore or BBC hacker? Well, further to the Chatterbox . . .

Tom Moffat
39 Pillinger Drive, Fern Tree, Tas 7101.

THE ETI-677 Chatterbox project has proved popular since it was presented in January, with many requests for information and applications software received since the project was mentioned, long before it was actually published.

January's ETI described the project itself, and included some software for the Microbee and Apple computers. This month we present some more software applications, for the popular Commodore and BBC micros.

The 'Beeb'

Connecting the Chatterbox to the BBC is easy, you just plug it in where the printer goes and configure the synthesiser for the Centronics option. You must supply the operating power externally; a 9 volt plug pack works nicely.

To send data to the Chatterbox you enable the Beeb's printer option using "VDU 2" and then print an ASCII string. You must disable the screen while doing this to prevent the ASCII rubbish from filling it up!

You'll notice that the Beeb version of "Sayings of the Daleks" is almost identical to the original Microbee program. Even most of the line numbers are the same. Both computers allow the generation of all the ASCII characters so the phonemes can be stored as ASCII strings instead of individual numbers in the DATA statements. Both computers also allow you to RESTORE to a line number, making it very easy to access the appropriate line of data. You can exit the BBC version of the program with "control-C".

We'll leave it to you to convert the Microbee's phoneme editor program to work on the Beeb. I ran out of steam.

LISTING 1: BBC "SAYINGS OF THE DALEKS"

```
 100 REM *** SAYINGS OF THE DALEKS *** for the B.B.C. Computer
 110 REM
 120 REM --- Tom Moffat, December 14, 1984
 130 REM
 140 MODE 3: REM Set screen for 80x25 text
 150 X=RND(16): REM Random number between 1 and 16
 160 X=(X-1)*10+1000: REM Index into data statements at line 1000
 170 RESTORE X: READ A1$: VDU 6: VDU 3: PRINT A1$
 180 READ A1$: VDU 2: VDU 21: PRINT CHR$(126);A1$;CHR$(126);
 190 IF INKEY$(400)<>CHR$(3) THEN 150: REM Delay and check for ^C
 200 VDU 6: VDU 3: END
 210 REM
 220 REM TEXT AND VOTRAX DATA INDEXED TO LINE 1000
 230 REM
1000 DATA The hostiles must be exterminated.
1005 DATA ys[}_jUaX_Lr_jN|BY_jzLJMAajr^
1010 DATA The Daleks must be obeyed.
1015 DATA ys^dXBY_Lr_jN|fN{a^
1020 DATA You must obey.
1025 DATA ihLr_jCfN{a
1030 DATA Take the patient to the examination centre.
1035 DATA jBaYyre`QrMjCjhy|B\Ro@LKMBaQqM_B@Mjz
1040 DATA You must cooperate. You must lie down.
1045 DATA ivwLr_jYtmUeckAaj~~bvwLr_jXUb^UwM
1050 DATA You will remain silent.
1055 DATA bvwmgXk|L`aM_UaXAMj
1060 DATA The Daleks are the superior being.
1065 DATA yrC^dXBY_Ukyr_vegkbzNlKT
1070 DATA We do not need assistance.
1075 DATA m|^vwMUjM|^H_K_jHM_
1080 DATA You will assasinate the members of the high council.
1085 DATA ivwmKXH_n_JM`jyrLBLNzRrOyr[U@iYUcM_BX
1090 DATA We have been sent by the Supreme Dalek.
1095 DATA ml[oON|M_BMjNUbxr_ivweklL^UXBY
1100 DATA We obey Davros. He is our leader.
1105 DATA mlfNBiC^oHOkU_~~[lg_UzXl^z
1110 DATA The prisoner is secured.
1115 DATA yrekK_rM@zgRC_@Yivz^
1120 DATA EMERGENCY! EMERGENCY! The enemy must be destroyed!
1125 DATA |Lz^ZrM_l~|Lz^ZrM_l~yl{MqLlLr_jNl^@_jkfi^
1130 DATA Nothing will interfere with the destiny of the Daleks.
1135 DATA MqyJTmIX@Mjz]gzmJxyr^A_j@M|rOyr^UXBY_
1140 DATA The collapse of Earth society will soon occur.
1145 DATA ysYUXne_rOzky_u_UaBj|mJX_vhMuYzk
1150 DATA You have not won Doctor. Join me and I will make you the
ruler of the world.
1155 DATA ivw[oOMUjmsM^SYjz~~ZuKMLlCnM^UIimJXLEaYCivwyskhXzsOyrmzX^
```

The Commodore

The easiest way to get speech data out of

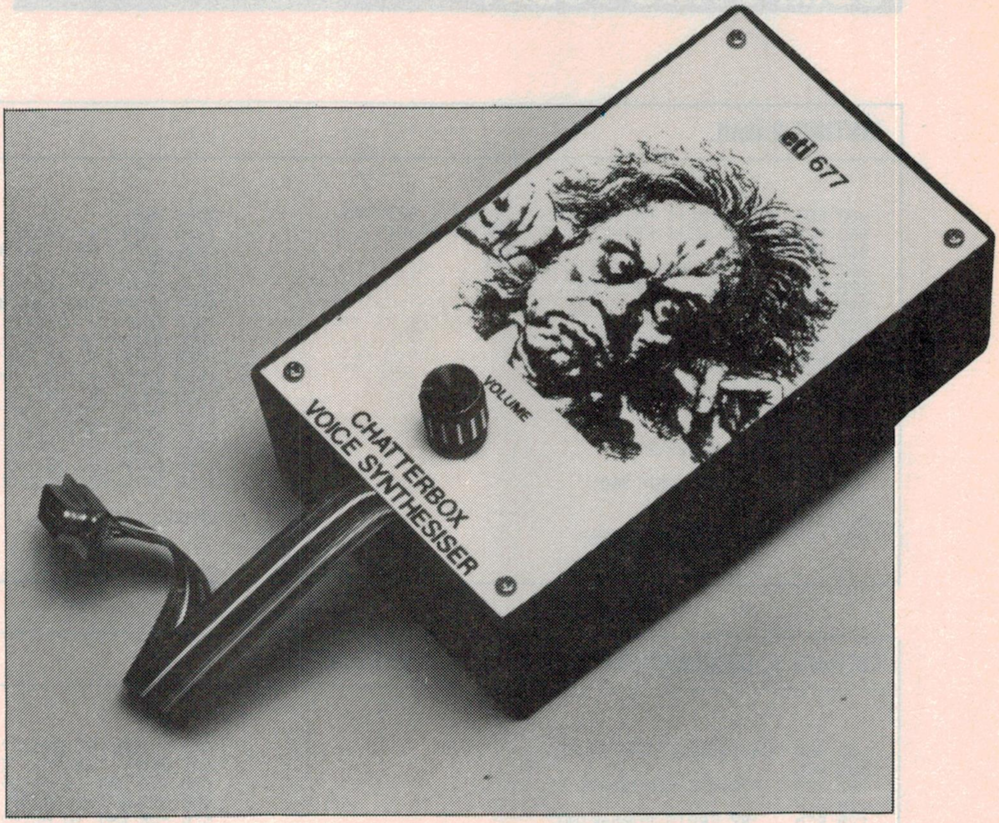
the Commodore and into the Chatterbox is via the user port. Flexible Systems has designed an interface card for this very purpose. It connects the Chatterbox into one of those scarce Commodore plugs and provides a power supply for the Chatterbox from the 9 volts ac provided by the Commodore.

The user port is best attacked with PEEKS and POKES. It is first set up as an output with "POKE 56579,255". You send a byte to the Chatterbox by POKEing it to 56577. You then keep inspecting 56589 until it is not zero (sub 790). This reads the Chatterbox busy signal and prevents a new phoneme being sent until the current one is finished.

Since we are POKEing things, the data must be stored in the DATA statements as numbers instead of ASCII strings. This takes up a bit more room, but as the old saying goes, that's the way the cookie crumbles!

Craig Ford-King has also written as version of the phoneme editor for the Commodore 64. When first run it does the same thing as the Microbee and says "testing". You then type in your new phonemes with one space between them and then hit "Return". The phonemes are displayed as the phrase is compiled. Use the standard Commodore edit procedures to edit the line; then press "Return" to hear it again. You can print the result to a printer with "PR (Return)". An illegal phoneme will be signalled in the appropriate way.

That makes four computers we've presented Chatterbox applications for. May the whole lot of them drive you bonkers with their never-ending babble!! ●



LISTING 2: COMMODORE CHATTERBOX SPEECH EDITOR

```
100 REM
110 REM - CHATTERBOX SPEECH EDITOR -
114 REM
115 REM -   FOR THE COMMODORE 64    -
120 REM
130 REM -    BY CRAIG FORD-KING     -
140 REM
150 REM -          6-12-'84         -
160 REM
170 REM
180 REM  OPEN I/O PORT
190 REM
200 POKE 56579,255
210 S=56577:R=56589
220 DIM A1$(255),B1(255)
270 PRINT CHR$(5);"❐■"
280 REM
290 REM  SAY 'TESTING' WHEN INITIALIZED
300 REM
310 A$="T EH S T I NG":GOTO 350
320 B$=A$:INPUT A$
330 IF A$=B$ THEN 770
340 IF A$="PR" THEN A$=B$:GOTO 820
350 WC=0:LC=1
360 FOR I=1 TO 255:A1$(I)="":NEXT I
370 IF MID$ (A$,LEN (A$),1)=" " THEN 390
380 A$=A$+" "
390 LA=LEN (A$)
400 REM
410 REM  FIND NUMBER OF PHONEMES
420 REM
430 FOR I=1 TO LA
440 IF MID$ (A$,I,1)=" " THEN WC=WC+1
450 NEXT I
460 REM
470 REM  SEPERATE THE PHONEMES FROM THE
475 REM               STRING
480 REM
490 FOR I=1 TO WC
500 A1$(I)=A1$(I)+MID$(A$,LC,1)
510 LC=LC+1
520 IF MID$(A$,LC,1)<> " " THEN 500
530 LC=LC+1
540 NEXT I
550 PRINT "❐"
560 REM
570 REM   SEARCH FOR PHONEME IN DATA
580 REM       AND GIVE IT A VALUE
590 REM
600 PRINT"SEARCHING FOR : ";
610 FOR I=1 TO WC
620 PRINT A1$(I);" ";
630 E=0
640 FOR J=1 TO 63
650 READ B$,P
660 IF B$=A1$(I) THEN B1(I)=P:E=1:J=63
670 NEXT J
680 IF E=1 THEN 690
685 PRINT:PRINT:PRINT"ILLEGAL PHONEME"
686 GOSUB 920:PRINT:E=0:I=WC:X=1:PRINT
690 RESTORE
700 NEXT I
710 IF X=1 THEN X=0:GOTO 880
720 PRINT
730 REM
740 REM  ADD PAUSES TO FRONT AND END
750 REM           THEN SAY IT!
760 REM
770 B1(0)=126:B1(WC+1)=126
780 FOR I=0 TO WC+1
790 POKE S,B1(I):GOSUB 960
800 NEXT I
810 POKE S,63:GOTO 870
820 REM
830 REM  PRINT OUT PHONEME CODES
840 REM
843 FOR TT=1 TO 40:PRINT"—";:NEXT TT
845 OPEN 1,4
850 PRINT#1:PRINT#1,"PHONEMES: ";A$:PRINT#1
855 PRINT:PRINT "PHONEMES: ";A$:PRINT
```

▶

LISTING 2 cont.

```
860 FOR I=0 TO WC+1:PRINT#1,B1(I);:NEXT I:PRINT#1
863 FOR I=0 TO WC+1:PRINT B1(I);:NEXT I:PRINT
865 CLOSE 1,4
867 FOR TT=1 TO 40:PRINT"¯";:NEXT TT
870 PRINT:PRINT"  ";A$:PRINT
880 GOTO 320
890 REM
900 REM  SAY ERROR MESSAGE
910 REM
920 FOR D=1 TO 23
930 READ P:POKE S,P:GOSUB 960
940 NEXT D:RETURN
954 REM
955 REM  READ INTERUPT
956 REM
960 IF PEEK(R)=0 THEN 960
970 RETURN
980 REM
990 REM  CODES FOR PHONEMES
1000 REM
1010 DATA "A",96,"A1",70,"A2",69,"AE",110,"AE1",111
1020 DATA "AH",100,"AH1",85,"AH2",72,"AW",125,"AW1",83
1030 DATA "AW2",112,"AY",97,"B",78,"CH",80,"D",94
1040 DATA "DT",68,"E",108,"E1",124,"EH",123,"EH1",66
1050 DATA "EH2",65,"EH3",64,"ER",122,"F",93,"G",92
1060 DATA "H",91,"I",103,"I1",75,"I2",74,"I3",73
1070 DATA "IU",118,"J",90,"K",89,"L",88,"M",76
1080 DATA "N",77,"NG",84,"O",102,"O1",117,"O2",116
1090 DATA "OO",87,"OO1",86,"P",101,"PA0",67,"PA1",126
1100 DATA "R",107,"S",95,"SH",81,"T",106,"TH",121
1110 DATA "THV",120,"U",104,"U1",119,"UH",115,"UH1",114
1120 DATA "UH2",113,"UH3",99,"V",79,"W",109,"Y",105
1130 DATA "Y1",98,"Z",82,"ZH",71
1145 DATA 126,121,111,106,67,75,82,67,111,77,74,88,124
1150 DATA 92,72,88,93,116,109,77,66,76,126

READY.
```

LISTING 3: COMMODORE "SAYINGS OF THE DALEKS"

```
100 REM  SAYINGS OF THE DALEKS
105 REM
107 REM   FOR THE COMMODORE 64
110 REM
120 REM    BY CRAIG FORD-KING
130 REM
140 REM         6-12-'84
150 REM
160 REM
170 REM    - OPEN I/O PORT -
180 REM
190 POKE 56579,255
200 S=56577:R=56589
210 PRINT"♥◘"
220 FOR I=1 TO 10:PRINT:NEXT I
230 PRINT TAB(13)"LOADING ARRAY"
240 DIM A1(30),A2(20),A3(13),A4(46),A5(36)
245 DIM A6(20),A7(47),A8(39),A9(33),A0(28)
250 REM
260 REM - READ DATA INTO ARRAYS -
270 REM
280 READ NI:A1(0)=NI:FOR C=1 TO NI
290 READ NO:A1(C)=NO:NEXT C
300 READ NI:A2(0)=NI:FOR C=1 TO NI
310 READ NO:A2(C)=NO:NEXT C
320 READ NI:A3(0)=NI:FOR C=1 TO NI
330 READ NO:A3(C)=NO:NEXT C
340 READ NI:A4(0)=NI:FOR C=1 TO NI
350 READ NO:A4(C)=NO:NEXT C
360 READ NI:A5(0)=NI:FOR C=1 TO NI
370 READ NO:A5(C)=NO:NEXT C
380 READ NI:A6(0)=NI:FOR C=1 TO NI
390 READ NO:A6(C)=NO:NEXT C
400 READ NI:A7(0)=NI:FOR C=1 TO NI
410 READ NO:A7(C)=NO:NEXT C
420 READ NI:A8(0)=NI:FOR C=1 TO NI
430 READ NO:A8(C)=NO:NEXT C
440 READ NI:A9(0)=NI:FOR C=1 TO NI
450 READ NO:A9(C)=NO:NEXT C
460 READ NI:A0(0)=NI:FOR C=1 TO NI
470 READ NO:A0(C)=NO:NEXT C
480 PRINT"□"
490 REM
500 REM - PICK A NUMBER 1 TO 10 -
510 REM
520 X=INT(RND(1)*10)+1
530 ON X GOSUB 580,600,620,640,660,680,700,720,740,760
540 REM
550 REM - PAUSE BETWEEN SAYINGS -
560 REM
570 FOR T=1 TO 500:NEXT T:GOTO 520
580 GOSUB 780:PRINT"    THE HOSTILES MUST BE EXTERMINATED"
590 FOR C=1 TO A1(0):POKE S,A1(C):GOSUB 790:NEXT C:RETURN
600 GOSUB 780:PRINT"        THE DALEKS MUST BE OBEYED"
610 FOR C=1 TO A2(0):POKE S,A2(C):GOSUB 790:NEXT C:RETURN
620 GOSUB 780:PRINT TAB(13)"YOU MUST OBEY"
630 FOR C=1 TO A3(0):POKE S,A3(C):GOSUB 790:NEXT C:RETURN
640 GOSUB 780:PRINT"  TAKE THE PATIENT TO THE EXAMINATION"
645 PRINT TAB(13) "CENTRE. PROCEED"
650 FOR C=1 TO A4(0):POKE S,A4(C):GOSUB 790:NEXT C:RETURN
660 GOSUB 780:PRINT " YOU MUST CO-OPERATE. YOU MUST LIE DOWN"
670 FOR C=1 TO A5(0):POKE S,A5(C):GOSUB 790:NEXT C:RETURN
680 GOSUB 780:PRINT TAB(9)"YOU WILL REMAIN SILENT"
690 FOR C=1 TO A6(0):POKE S,A6(C):GOSUB 790:NEXT C:RETURN
700 GOSUB 780:PRINT "   THE DALEKS ARE THE SUPERIOR BEING."
705 PRINT TAB(7)"WE DO NOT NEED ASSISTANCE"
710 FOR C=1 TO A7(0):POKE S,A7(C):GOSUB 790:NEXT C:RETURN
720 GOSUB 780:PRINT" YOU WILL ASSASINATE THE MEMBERS OF THE"
725 PRINT TAB(14)"HIGH COUNCIL"
730 FOR C=1 TO A8(0):POKE S,A8(C):GOSUB 790:NEXT C:RETURN
740 GOSUB 780:PRINT " WE HAVE BEEN SENT BY THE SUPREME DALEK"
750 FOR C=1 TO A9(0):POKE S,A9(C):GOSUB 790:NEXT C:RETURN
760 GOSUB 780:PRINT "    WE OBEY DAVROS. HE IS OUR LEADER"
770 FOR C=1 TO A0(0):POKE S,A0(C):GOSUB 790:NEXT C:RETURN
780 PRINT"□":FOR T=1 TO 10:PRINT:NEXT:RETURN
790 IF PEEK(R)=0 THEN 790
800 RETURN
810 REM
820 REM  AND NOW THE VOTRAX DATA...
830 REM
840 DATA 29,121,115,91,125,95,106,85,97,88
843 DATA 95,76,114,95,106,78,124,66,89,95,106
845 DATA 122,76,74,77,65,97,106,114,94
850 DATA 19,121,115,94,100,88,66,89,95,76,114
855 DATA 95,106,78,124,102,78,123,97,94
860 DATA 12,105,104,76,114,95,106,67,102,78,123,97,67
870 DATA 45,106,66,97,89,121,114,101,96,81,114
873 DATA 77,106,67,106,104,121,124,65
875 DATA 92,82,111,64,76,75,77,66,97,81,113
876 DATA 77,95,66,64,77,106,122,126,126,101
877 DATA 107,117,95,124,105,94
880 DATA 34,98,118,119,76,114,95,106,89,116
883 DATA 109,85,101,99,107,65,97,106,126,126
885 DATA 98,118,119,76,114,95,106,88,85,98,94,85,119,77,67
890 DATA 19,98,118,119,109,103,88,107,124,76
895 DATA 96,97,77,95,85,97,88,65,77,106
900 DATA 46,121,72,67,94,100,88,66,89,95,100
903 DATA 107,121,72,95,118,101,103,107,98
905 DATA 122,78,108,75,84,126,126,109,124,94
906 DATA 118,118,77,100,106,77,124,94,72,95
907 DATA 103,95,106,72,77,95,67
910 DATA 38,105,118,118,109,103,88,72,95,110
913 DATA 95,74,77,96,106,121,66,76,66,76,78
915 DATA 122,95,100,79,121,85,91,85,64,105,89
917 DATA 85,99,77,95,66,88,67
920 DATA 32,109,108,91,111,79,98,124,77,95,66
923 DATA 77,106,78,72,64,105,121,64,95,105
925 DATA 118,119,101,107,108,76,94,85,88,66,89,67
930 DATA 27,109,108,102,78,66,105,67,94,111,79
933 DATA 107,85,95,126,126,91,108,103,95
935 DATA 85,99,122,88,108,94,122,67

READY.
```

ALTRONICS COMPONENTS NEW PRODUCTS

DELIVERED RIGHT TO YOUR DOOR NEXT DAY*

*Altronics Famous Jetservice Delivery to all Capital Cities and suburbs—Country Areas please allow additional 24-48 Hours

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FREE FREIGHT
Exclusive to Altronics—yes we will deliver your Monitor free right to your door.

High Definition Computer Monitor

There are a number of low cost 'Hobbyist' monitors around these days at prices unheard of a year or so ago. However, they all suffer from poor to medium definition or resolution—hence eye strain becomes a real headache. The situation has all changed with the 1985 release of the superb Micron Series 3. Non glare, naturally, and screen character resolution well worthy of mating up with top end personal or professional computers.

• 1050 lines resolution at centre screen • 22MHz bandwidth • Video input impedance switch allows networking use • **Incredible**—repeat—**Incredible—Resolution.**

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AMBER AND GREEN SCREEN MODELS

D 1115	Green Non Glare	**$179**
D 1116	Amber Non Glare	**$189**

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PRESSURE SENSITIVE—ETCH RESISTANT PC ART AIDS BY IZUMIYA

Altronics proudly announce the inclusion to our range of the FANTASTIC IZUMIYA PCB ARTWORK AIDS—The incredible feature of IZUMIYA tapes, symbols etc. is, unlike most others, they are etch resistant—that is you can lay artwork direct on to the copper face of the PCB and etch directly with ferric chloride! — Naturally you can use them to prepare finished artwork to paper, film, metal in the normal manner.

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ALL $1.95ea or 10 Up SAVE OR MIX $1.60

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2mm	H 8601
3mm	H 8604
4mm	H 8605

OVAL PADS

3 x 2mm	H 8610
4.5 x 3mm	H 8611

DIL IC PADS

Single	H 8641
Triple	H 8642

TRACKS

0.5mm	H 8621
0.8mm	H 8624
1mm	H 8625
2mm	H 8630

T-CONNECTORS 1mm Gauge — H 8635

EDGE CONNECTORS 3.17mm Pitch — H 8646

NUMERIC 2.7mm/H — H 8658

ALPHA

3.2mm/H	H 8673
3.8mm/H	H 8659

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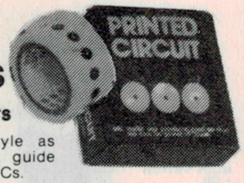
H 8702	0.5mm x 16M	**$2.95**
H 8703	1.0mm x 16M	**$2.95**
H 8704	1.5mm x16M	**$2.95**
H 8705	2.0mm x16M	**$2.95**
H 8710	Pack of any 4	**$10.00**

ROLL PACKS



Ideal for Trade Users

Contents vary each style as dimensions differ. As a guide doughnuts contents 250 PCs.

DOUGHNUTS

2mm	H 8802	**$3.50**	**$3.25**
3mm	H 8803	**3.50**	**3.25**
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ALTRONICS QUALITY TELEPHONE EQUIPMENT

Famous Call Master Phone Answering Machines

12 Months Warranty

With Callmaster you'll never miss a call again just because you weren't near the telephone when it rang. Callmaster answers for you, in your own voice if you wish, then records and stores the callers' messages for your convenience.
24 hours a day, 7 days a week, Callmaster is on the job. Your callers will appreciate the chance to communicate their information to you, without enduring the frustration of repeatedly dialling an unanswered number.

DUAL CASSETTES
This important feature is provided by both A 0516 non remote and A 0515 remote. One cassette delivers your outgoing announcement and the other records incoming messages. Outgoing messages need be recorded once only and incoming messages are stored on the other standard sized cassette and can even be played back on your tape deck or car stereo.

MONITORING FUNCTION
Enables you to "screen" incoming calls, giving you the option of speaking with the caller personally or allowing your Callmaster to continue recording normally.

CONDENSOR MICROPHONE
Callmaster features a built-in microphone which records your outgoing messages. Convenient, and can't be lost.

LARGE INCOMING MESSAGE CAPACITY
Up to 150 messages can be recorded, using a C60 leaderless cassette and based on an average message time of 12 seconds per call.

EASY CHANGE OF OUTGOING MESSAGES
Your Callmaster endless loop cassette gives a 20 sec. announcement, optional cassettes are available in lengths of 12, 15, 30, 45 or 60 seconds. (If required, your machine can be modified to use 120 seconds outgoing message cassettes.)

CALLING PARTY CONTROL
Callmaster stops recording the instant your caller hangs up, eliminating annoying blank spots between incoming messages.

Standard Model A 0510 $229
Remote control model A 0515 $299

REMOTE CONTROL
(A 0515 only)— Receive your messages from any telephone, anywhere in the world! The decoder enables you to command playback of incoming messages from any telephone. You also have the option to remotely rewind the incoming message cassette giving full capacity again or continue to accumulate all incoming messages.

FAST FORWARD
(A 0515 only)— Whilst playing back your incoming messages, the convenient non-locking fast forward key may be depressed, advancing the incoming message cassette for the required duration.

PRECISION AND QUALITY
Callmaster is designed especially for Australian telephone conditions and precision manufactured in Japan, assuring unequalled performance and reliability.

TELECOM
Callmaster A 0510 and A 0515 are both permitted for direct connection to the telephone network. You just plug it in!
Telecom Australia Permit # C81—16—18.
Energy Authority of N.S.W. Certificate # CS2029N.

ALL THESE FEATURES PLUS A FULL 12 MONTHS WARRANTY AGAINST FAULTY WORKMANSHIP OR MATERIALS

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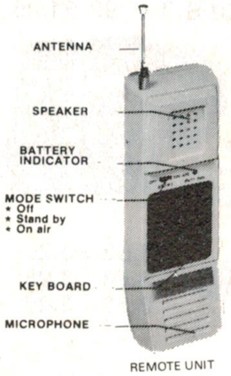
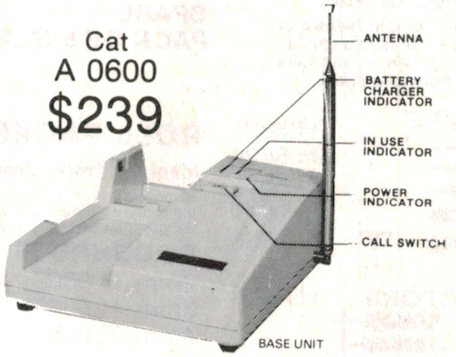
The handset is light, comfortable to use and attractively styled. **Absolutely perfect for use around the garden or backyard pool etc.** The remote handset tone ringer can be activated remotely from the base unit, providing paging and intercom from a parallel phone.

Cat A 0600 **$239**





DOC Permit RFM E002/026
Telecom Permit C83-35-9

COMMUNICATION RANGE: Approx. 100m under ideal conditions.
POWER SUPPLY VOLTAGE: Base unit AC 240V 50 Hz
Input 12V DC 300mA
Remote Telephone DC 4.8V

BASE RECEIVER:		
Frequency (Single Channel)		40.025—40.225MHz
Sensitivity for 20dB Signal to Noise		0.5uV
Adjacent Rejection	+ 15KHz	50dB
	—15KHz	50dB
REMOTE TRANSMITTER:		
Frequency (Single Channel)		40.025—40.225MHz
REMOTE RECEIVER:		
Frequency (Single Channel)		1.725—1.785MHz
Sensitivity for 20dB S/N		0.5uV
Adjacent Channel Rejection	+ 15KHz	50dB
	—15KHz	50dB
Consumption Current		
Stand-by	less than	8mA
ringer	less than	20mA
during conversation	less than	50mA
RECHARGEABLE BATTERIES (REMOTE):		
Nominal Capacity		250mAH
Nominal Voltage		4x1.2V = 4.8V

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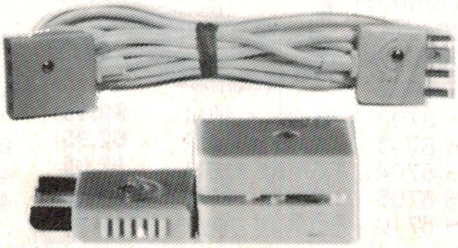
Now you can have your Telephone in the backyard or just on the other side of the lounge room with these nifty telephone leads. **Double Adaptor** allow two phones into the one line. Ideal for cordless phones etc.



P 0990 5 Metre extn.lead **$14.95**
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With memory Re-dial
Great for use as a 2nd phone around the house or office.

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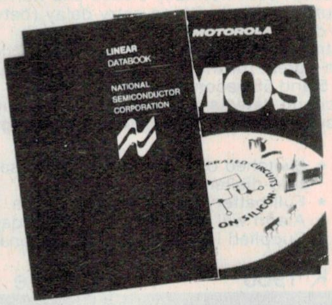

NATIONAL SEMICONDUCTOR

INTERFACE
This databook provides complete specifications for a variety of transmission line drivers/receivers, peripheral/power drivers and level translators/buffers. Product selection guides list applications information and operating features. Memory, dynamic memory, microprocessor, data communications and disk support products are also covered in the data book. The interface appendices section contains cross reference guides; the programmable logic section describes the technology, design and gives application suggestic

Pages: 1520 **Year: 1983**

B 1005 .... **$13.50**

5 Up **$12.00**

DATA CONVERSION ACQUISITION DATABOOK
The 1984 edition of the Data Conversion/Acquisition Databook is one of the most comprehensive in the industry. It contains specifications for high technology conversion products in the analog signal path, both preceding and following the conversion process. Combining high volume production capability with leading edge technology such as thin film resistors, laser trimming and advanced micro CMOS and bipolar processing, has helped develop products best suited to your design needs.

Pages: 1232 **Year: 1984**

B 1007 .... **$13.50**

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LINEAR DATABOOK
The 1982 edition of the National Semiconductor Linear Databook is the most comprehensive available. It presents approximately 2000 pages of specifications for our high-technology linear products. Applications, descriptions, features and diagrams in this databook include detailed sections for Voltage Regulators, Op Amps, Voltage Comparators, A to D, D to A Converters, Industrial Blocks and Audio and TV Circuits. The databook also features advanced telecommunication devices and speech synthesis (DIGITALKER), plus other non-state-of-the-art linear products offering performance, economy, quality and reliability.

Pages: 1952 **Year: 1982**

B 1010 .... **$15.00**

5 Up **$14.00**

LINEAR SUPPLEMENT
The 1984 Linear supplement provides the most recent information on Nationals new linear products. This supplement also provides a comprehensive index published in the Master Databook. New products designed are indicated by an Asterisk and in bold type. Revised data sheets are listed in bold type. Nationals supplement databook system allows you to make product selections of their latest product offerings.

Pages: 566 **Year: 1984**

B 1011 .... **$7.50**

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LOGIC DATABOOK
National's new Logic Databook covers five of their logic families: TTL (54/74) Schottky (54S/74S) low power Schottky (54S/74S) high speed (54H/74H) and low power (54L/74L). The Logic Databook—especially organised for quick and easy referencing—offers two complete functional indices and selection guides, one for SSI and one for MSI devices. In addition, it includes over 100 connection diagrams and test waveforms to help speed the design-in cycle. All in all, it's probably the most comprehensive collection of practical information ever assembled on such a broad line of practical components.

Pages: 550 **Year: 1981**

B 1015 .... **$11.0**

5 Up **$10.00**

MOS MEMORY DATABOOK
The 1984 MOS Memory Databook is a comprehensive collection of information advanced, high-density memory products covering the spectrum of this mainstream semiconductor component category National Semiconductor has an array of advanced technology processes to apply to memory design and development. These range from high-density triplepoly process used in the most advanced RAMs, the small-geometry, silicon gate, oxide-isolated micro-CMOS technology which is now being applied to high-performance memory devices for the first time.

Page: 256 **Year: 1984**

B 1025 .... **$7.50**

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HYBRID PRODUCTS DATABOOK
The Hybrid Products Databook is the only National Semiconductor publication that contains complete information on all our hybrid semiconductor products. Included are precision thin film and thick film products which provide the user with standard functions from operational amplifiers to converters with capabilities beyond those of current monolithic technology. Product selection guides and an application section are also included.

Pages: 792 **Year: 1982**

B 1045 .... **$9.95**

5 Up **$9.25**

TRANSISTOR DATABOOK
National Semiconductor has added many new transistors and product families since publication of the last databook. Many have already been widely acclaimed by users. In addition to small-signal, power-bipolar and field effect transistors that have been the mainstay of our catalog, there is a section for multiple-field-effect transistors. More part numbers will be added as market needs expand. To keep current on all new National transistors, please contact your National sales representative or franchised distributor and ask to be placed on the customer mailing list.

Pages: 558 **Year: 1982**

B 1050 .... **$9.95**

5 Up **$9.25**

CMOS DATABOOK—1984
The CMOS Databook contains the industry's most comprehensive collection of high-performance CMOS products available. Our early commitment to micro-CMOS technology has made possible the development of a broad spectrum of advanced devices that will simplify your design and ensure state-of-the-art systems. Micro CMOS technology describes National's array of small-geometry, silicon gate, oxide-isolated processes used to build the products in this book. Using N- or P- well substrates and multiple-layer metal or polysilicon-interconnect structures, micro CMOS processes feature sizes of 3.0, 2.0 or 1.5 microns, with submicron feature sizes in development.

Pages: 1520 **Year: 1984**

B 1030 .... **$13.50**

5 Up **$12.00**

VOLTAGE REGULATOR HANDBOOK
With the variety of fixed and variable regulator technology currently available, the 336 page Voltage Regulator Handbook becomes a must for the selection of three terminal and dual tracking components that meet the system requirement while utilizing the most cost effective approach. Beginning with product selection procedure and a data sheet summary, the text continues with easily accessible information about booster circuitry, power transformer and filter specifications, test methods, manufacturers' cross reference, and extended use applications for National's regulators.

Page: 336 **Year: 1982**

B 1055 .... **$9.95**

5 Up **$9.25**

MOTOROLA BONUS OFFER
SET OF 9 TITLES

B 9995 .... **$99.00**

SAVE $30

NATIONAL SEMI BONUS OFFER
SET OF 10 TITLES

B 9996 .... **$89.00**

SAVE $22

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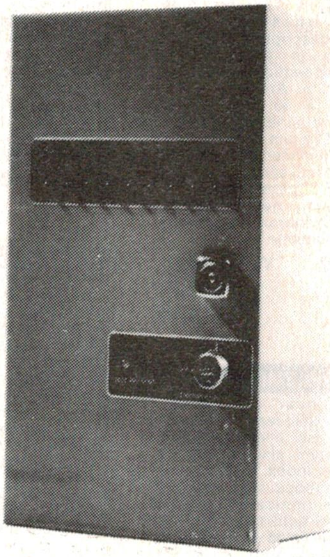
FOR NEXT DAY JETSERVICE DELIVERY

ALTRONICS COMPONENTS

Build This
MULTI SECTOR BURGLAR ALARM STATION
Superb new Kit Project by Electronics Australia.

K 1900 $139



Save $$$ on the cost of commercial equivalents

Within the Capacity of the beginner constructer

Professionally Engineered by the design team at Electronics Australia

Protect your Home or Business from Intruders with this "State of the Art" Burglar Alarm System.

Over the last few years, House Break-ins have increased dramatically—a check of recent police statistics is simply horrifying! The recovery rate of stolen goods is very low. This is partly due to the sheer difficulty in identifying goods as well as the incredible volume of property stolen.

Now more than ever before, it makes extremely good sense to build and install this ingenious Multi-Sector System.

This unique Alarm System incorporates the features of the more expensive commercial models—**at a fraction of the price.**

FEATURES:

- ★ Alarm has 8 separate input circuits—8 sectors can be monitored independently.
- ★ Each input circuit is provided with an indicator LED and a sector On/Off switch
- ★ Individual sector isolation allows the user to have some areas of the premises habited while others remain protected.e.g. Inside Off/Outside On.
- ★ Inputs accept both normally closed and normally open sensors
- ★ Two Inputs provided with an entry delay (between 10-75 sec)
- ★ Alarm is disabled by front panel key switch
- ★ Internal trip warning buzzer—alerts owner/occupant of pending alarm operation—great for the "forgetful" amongst us. This buzzer is pre-settable between 5 and 55 seconds prior to Alarm.
- ★ Unique circuit detects automatically when any N/O or N/C loops are either open circuit or dead short.**e.g.someone trying to bridge reed switches etc.**
- ★ Automatic muting of the siren driver when under test—so as not to wake the whole neighbourhood.
- ★ Fully variable exit delay—between 5 and 45 seconds
- ★ Will drive a separate external horn speaker
- ★ Alarm output variable between 1 and 15 minutes.
- ★ When triggered—gives a switched double pole output for connection to external devices.e.g. Bells,TV Camera etc.
- ★ Switched output can be used to send a silent alarm through an auto-dialler circuit or similar.
- ★ Full battery back up provided via. 12V—1.2Ah battery
- ★ Alarm will operate for approx.2 days with mains disconnected.
- ★ Supplied in an attractive functional security case.

K 1900 A Mere **$139.00**

Suggested Alarm Accessories for use with the Multi Sector Alarm System

Weatherproof Horn Speakers
5 and 10 watt

5W
C 2010 **$9.50**
10Up **$8.90**

10W
C 2015 **$11.50**
10Up **$9.50**

Weatherproof Siren Horn

12V DC
Deafening
Siren Wail

S 5158 **$22.50**
10Up **$20.00**

PIEZO ALARM

Similar to "Sonalert" type. Absolutely ear piercing sound. Recommended voltage 5—15V DC. Ideal for almost all audio signalling applications. i.e. Fire, water and gas signalling, computer alarms, etc.

S 5166 **$4.95**
10Up **$4.50**

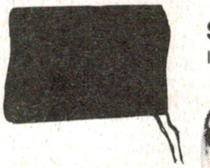
DUAL FUNCTION

Same physical dimension as S 5066. Gives either a pulsed output (siren) or a continuous tone. 3 wire connection enables selection of either output.

S 5170 **$5.95**
10Up **$5.00**

Pressure Mats

Ultra thin switch mat for under carpet or mat etc.



S 5184 **$19.95**
10Up **$17.50**ea

Reed Switch and Magnet Sets
3 Types (Surface Mount)

			10Up
S 5155	N/C SW	**$2.50**	**2.20**
S 5156	N/O SW	**$2.95**	**2.10**
S 5153	SPDT	**$2.98**	**2.59**

Changeover type

NEW Concealed Reed Switch and Magnet Set

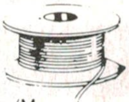
Simply brilliant! Just drill recess your door or window and the magnet is flush mounted and thus "invisible". The Reed Switch segment is similarly mounted into the door frame or window frame and wired into your system.

Can't be tampered with Professional Quality

S 5152 **$3.98**
10Up **3.50** ea

Fig '8' Cable

Ideal for runs to and from pressure mats, sirens, reed switches, horn speakers or just about anything low voltage

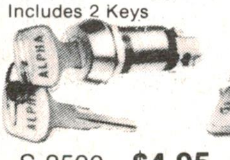


W 0200 2 x 14/.14 **.20¢** per/M

Grey and Black **$10.00** per 100M Roll

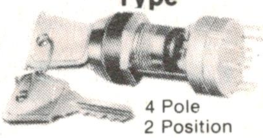
Security Key Switches

Standard Type
Includes 2 Keys



S 2500 **$4.95**
10Up **$4.10**

High Security Type

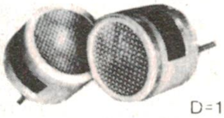


4 Pole
2 Position

S 2510 **$5.50**
10Up **$5.00**

ULTRASONIC TRANSDUCERS

S 5110
$9.90 pr.



D=16mm H=12mm

Ultrasonic transmitter and receiver transducers operating at 40KHz + or - 1KHz. Perfect for security applications etc. i.e. alarm sensors, counting sensors, remote control sensors and many other uses.

Sensitivity TX 106db RX -65db **Dispersion angle** 20 deg. **Max input voltage** 20V RMS **Impedance** TX 500 Ohms RX 30K Ohm. **Operating range** up to 9M

Please Note only sold as Matched Pairs of RX,TX

MINI BUZZER 5-15V DC

Handy little solid state low current buzzer is ideal for use with signaling panels, alarm systems, in the car etc.

S 5162 **$1.95**

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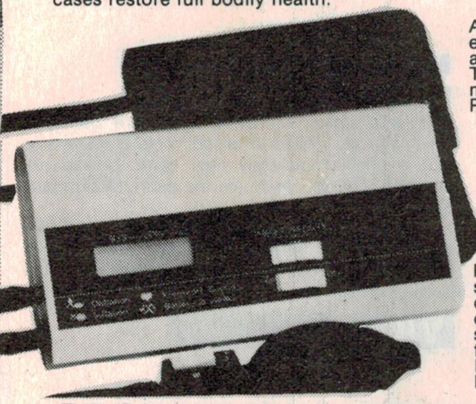
BANKCARD HOLDERS—PHONE ALTRONICS TOLL FREE 008 • 999 • 007 FOR NEXT DAY JETSERVICE DELIVERY

BLOOD PRESSURE & HEART RATE MONITOR

Why Risk Unnecessary Heart Attack?

A simple (take the reading yourself) periodic check of your blood pressure and pulse provides an "inward look" into a vital aspect of your bodily health. Heart desease strikes down many people in their early 40's (or even 30's). The tradgedy remains that had such victims been alerted, remedial medical, physical and dietary action could have been prescribed to avoid illness and in many cases restore full bodily health.



A Superb Gift for the dedicated fitness enthusiast **Absolutely essential** for those over 40 and concerned with their health, or on Fitness Therapy. Use this **easy to operate** Monitor to measure your pulse (or heart rate) and Blood Pressure.

DON'T PAY ~~$150~~

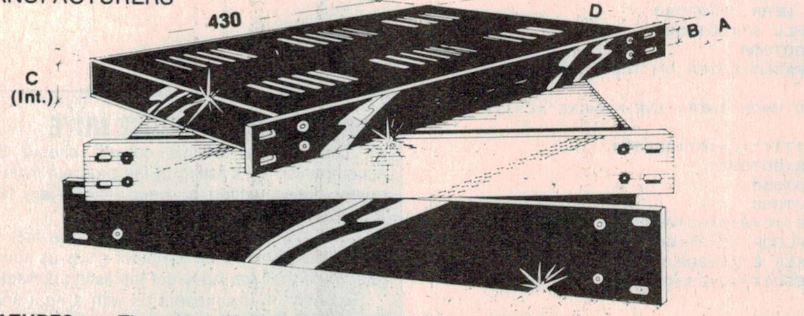
X 3055

Now Only **$89**

Remember high blood pressure is in itself symptomless and the usual forerunner to future chronic heart disease. **Features** include "error" display warning of incorrect use. Handbook supplied will enable anyone in your family to be fully conversant with this monitor in minutes. Easy to read display of Systolic and Diastolic Blood Pressure and Pulse Rate.

PROFESSIONAL SERIES RACK CABINETS

NOW YOUR PREAMPS, AMPS, CONTROL MODULES MONITOR PANELS ETC. CAN LOOK EVERY BIT AS GOOD AS TECHNICS, NAKAMICHI AND OTHER TOP MANUFACTURERS



FEATURES:— • These beautifully crafted rack cabinet boxes will give your equipment a real Ist class appearance • Aluminium construction with removable top and bottom steel cover panels • All dimensioning conforms to the International Standard • Natural or Black finish • Ventilated lid • Deluxe finish front panel • Individually cartoned • Supplied in Flat Pack Form—Easily assembled in minutes—**Side Elevations:—** • D= 254mm C (Internal Chassis Height) • B (Mounting Bolt Centres).

SIX NATURAL AND BLACK FINISH MODELS

The Black or Natural finish cabinets are each available in 44mm, 88mm or 132mm high models. Mounting hole centres conform exactly to International Racking Specifications both vertically and horizontally.

Cat. No.	Finish	A	B	C	ea.	5+
H 0401	Natural	44	34	38	**$45.00**	**$42.50**
H 0402	Natural	88	57	82	**55.00**	**52.50**
H 0403	Natural	132	89	126	**59.95**	**55.00**
H 0411	Black	44	34	38	**45.00**	**42.50**
H 0412	Black	88	57	82	**55.00**	**52.50**
H 0413	Black	132	89	126	**59.95**	**55.00**

30 WATT LINE OUTPUT PUBLIC ADDRESS AMPLIFIER

with balanced

Mic Input and Muting

A 2000

$199.50

2 year Warranty

Developed right here in Australia by leading Audio Designer Guiseppe Iacusso — the Altronic A 2000 utilizes balanced input, drive output and feedback circuitry to achieve performance and stability unheard of with low cost amplifiers. The A 2000 will operate happily into all sorts of capacitive and inductive loads, Long lines, speaker transformers etc. Eminently suited for use by **Schools, sporting clubs, function centres** as well as with professional installations **(paging systems—background music).**

SPECIFICATION:

• **Balanced Low Impedance Mic Input** 200—600 ohm. Input socket 5 Pin Din (Line 1 and 3,2 earth) • **Unbalanced Low Impedance Mic Input** 200—600 ohm (Line 1,3 and 2 earth) • **Mic Muting** on Pins 4,5. Mutes auxiliary channel (or music programme) when operated. • **Auxiliary Input** 100K ohm RCA • **Treble and Bass Controls** Individual boost and cut controls provided for auxiliary channel only • **Low Z Speaker Output** 4—16 ohm • **Line Output** 100V line (balanced) • **Power Output** Full 30 watts RMS into either 4 ohm or 100V line • **Distortion** typically less than 1% • **Frequency Response** 60Hz to 12Khz

ALTRONICS
COMPONENTS

105 STIRLING STREET, PERTH
FOR INSTANT SERVICE
PHONE ORDER TOLL FREE
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PERTH METRO AND A/HRS ORDERING SERVICE
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All Mail Orders
Box 8280, Stirling St. Perth WA 6000

PACKING AND DELIVERY CHARGES

$3.00 Delivery Australia Wide - We process your order the day received and despatch via. Australia Post. Allow approx. 7 days from day you post order to when you recieve goods. Weight limited 10kgs.

$5.00 Overnight Jetservice - We process your order the day received and despatch via overnight jetservice Courier for delivery next day Country areas please allow additional 24-48 hours. Weight limit 3kgs.

$10.00 Heavy Heavy Service - All orders of 10kgs or more must travel express Road - Please allow 7 days for delivery.

Insurance - As with virtually every other Australian supplier, we send goods at consignees risk. Should you require comprehensive insurance cover against loss or damage please add 1% to order value (minimum charge $1) When phone ordering please request "Insurance".

Toll Free Phone Order - Bankcard Holders can phone order toll free up to 6pm Eastern Standard Time. Remember with our **Overnight Jetservice** we deliver next day.

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Wanted in all Areas of Australia—Phone Steve Wroblewski on (09) 381 7233 for Details.

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Jaycar 264 6688
Radio Despatch 211 0191
SUBURBAN
CARLINGFORD
Jaycar 745 3077
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David Ryall Electronics 982 7500
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ECQ Technics 3710879

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Todays Electronics21 2777
MANDURAH
Kentronics 35 3227
WYALKATCHEM
D & J Pease 81 1132

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DARWIN
Ventronics 81 3491
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Ascom Electronics 52 1713
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ACT

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Scientronics..... 54 8334
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```
10 PRINTCHR$(14)"■MYSTERY SHIP■■BY P.BAGUST"
20 PRINT"■■YOU'VE BEEN TELEPORTEDONTO A SPACESHIP ABOUTTO COLLIDE WITH EARTH. ST
OP IT!■■"
30 P=2:M=11:T=-1:L=3:K=10:S=12:V=36878:W=36877:X=36874:TI$="000000"
40 PRINT"■YOU'RE IN THE":ONPGOTO310,320,330,340,350,360,370,380,390,400,410,420
50 POKEV+1,C:IFL<0THENL=-P:PRINT"CARRYING LAZER"
60 IFU=4ANDP=2THENPRINT"■TELEPORT ACTIVATES AND THEN SUDDENLY...■■":GOTO870
70 IFK<0THENK=-P:PRINT"GOT KEY"
80 IFS<0THENS=-P:PRINT"WEARING SPACESUIT"
90 IFM<0THENM=-P:PRINT"A VERY NASTY ALIEN IS RUNNING AT YOU!!!":GOTO850
100 PRINTTAB(16)TI$
110 IFTI$>"003000"THENPRINT"TIME UP-SHIP CRASHES!":GOTO830
120 IFT>-1ANDS=-PTHENT=T-1:PRINTT"OXYGEN UNITS LEFT":IFT=0THEN900
130 PRINT" ■■WHAT NOW?■■"
140 GETI$:IFI$=""THEN140
150 IFP=MTHENM=-P
160 IFI$="E"THENA=1:ONPGOTO650,670,670,670,650,670,660,670,780,650,660,670
170 IFI$="W"THENA=-1:ONPGOTO670,660,670,670,670,650,670,660,650,670,650,650
180 IFI$="N"THENA=-3:ONPGOTO670,670,670,650,650,660,670,650,670,650,650,670
190 IFI$="S"THENA=3:ONPGOTO650,650,650,670,650,650,650,650,670,670,670,670
200 IFI$="F"ANDL><-PTHENPRINT"HAVE NO WEAPON":GOTO130
210 IFI$="F"THENGOTO790
220 IFM=-PTHENPRINT"NOT QUICK ENOUGH ALIEN KILLS YOU!!":GOTO900
230 IFI$="X"THENONPGOTO510,520,530,550,570,590,590,590,610,620,590,640
240 IFI$="O"ANDK=-PTHENGOTO680
250 IFI$="O"THENPRINT"NEED KEY":GOTO50
260 IFI$="C"THENGOTO740
270 PRINT"OPERATE ONE KEY ONLY! E-EAST  W-WEST  F-FIRE N-NORTH   S-SOUTH"
280 PRINT"  O-OPEN   X-EXAMINE   C-CARRY AND/OR WEAR.":GOTO40
310 C=232:PRINT"BLACK OF SPACE.DOOR E HOLE IN HULL S":GOTO50
320 PRINT"TELEPORT ROOM.CAN GO S DOOR W":C=255:GOTO50
330 PRINT"ARMS LOCKER . DOOR S":IFP=3ANDL=3THENPRINT"LAZER ON THE FLOOR":C=202:G
OTO50
340 PRINT"CONTROL ROOM.HOLE N   THERE IS WRECKED MACH-INERY EVERYWHERE":C=174:GO
TO50
350 PRINT"CREW ROOM,CAN GO N,S,E THERE IS GRAFFITTI":C=187:GOTO50
360 PRINT"ARMOURY.CAN GO W,S    CABINET N":C=156:GOTO50
370 PRINT"STORE ROOM.CAN GO S   DOOR E":C=171:GOTO50
380 PRINT"CORRIDOR.CAN GO N,S   DOOR W":C=204:GOTO50
390 PRINT"SLEEPING ROOM.CAN GO N LAUNDRY CHUTE E":C=218:GOTO50
400 PRINT"LAUNDRY.CAN GO TO N,E MANY THINGS ON FLOOR":C=25:GOTO50
410 PRINT"ESCAPE BAY-NO LIFEBOAT CAN GO N,W.LOCKER E":C=202:GOTO50
420 PRINT"SUIT LOCKER.CAN GO W  THERE IS A SPACESUIT":C=233:GOTO50
510 PRINT"HOLE MADE BY METEOR":GOTO50
520 PRINT"DOOR IS MARKED AIRLOCK":GOTO50
530 IFL=3ORL=-3THENPRINT"LAZER HAS ONLY 1 CLIP":GOTO50
540 PRINT"■NOTHING HERE!■":GOTO50
550 IFU<>4THENPRINT"DESTRUCT SWITCH CLOSED":GOTO50
560 PRINT"DESTRUCT SEQUENCE HAS COMMENCED!ABANDON SHIP":GOTO50
570 PRINT"IT READS-HIT BY METEOR CONTROL ROOM DAMAGED"
580 PRINT" SHIP WILL HIT PLANET AT 003000! P.S. BEWARE THE ALIEN!":GOTO50
590 IFU><PTHENPRINT"■LOCKED-NEED A KEY■":GOTO50
600 PRINT"■DOOR IS UNLOCKED!■":GOTO50
610 PRINT"CHUTE IS VERY STEEP":GOTO50
620 IFP=KTHENPRINT"■THERE IS A KEY!■":GOTO50
630 PRINT"NOTHING OF INTEREST!":GOTO50
640 PRINT"SUIT HAS 15 AIR UNITS":GOTO50
650 PRINT"OK":P=P+A:GOTO40
660 IFU=PTHEN650
670 PRINT"CANT DO THAT":GOTO50
680 PRINT"OK":U=P:POKEV,15:B=0:FORY=128TO255STEP11:POKEX,Y:FORZ=1TO100:NEXTZ:B=B
+1
690 IFB=3THENB=0:POKEX,0
700 NEXTY:POKEX,0:POKEV,0
710 IFP=2THENPOKEV,15:POKEX,170:POKEW,240:FORY=1TO2000:NEXTY:POKEV,0:POKEX,0:POK
EW,0:Z=1
720 IFZ=1ANDS><-PTHENPRINT"ALL AIR SUCKED THROUGHAIRLOCK-YOUR DEAD!":GOTO900
730 GOTO40
740 IFP=LTHENL=-P:PRINT"OK":GOTO130
750 IFP=KTHENK=-P:PRINT"OK":GOTO130
760 IFP=STHENS=-P:T=15:PRINT"OK":GOTO130
770 PRINT"NO CAN DO":GOTO130
780 PRINT"W■H■E■E■E■E■E■E!":GOTO650
790 POKEV,9:FORY=1TO30:FORZ=250TO240STEP-1:POKEV-2,Z:NEXTZ:FORZ=240TO250:POKEV-2
,Z:NEXTZ
800 POKEV-2,0:NEXTY:POKEV,0
810 IFL=MTHENPRINT"ALIEN AND LAZER BOTH  DISINTERGRATE":L=0:M=6:GOTO130
820 PRINT"BACKLASH KILLS YOU"
830 POKEV-1,220:FORY=15TO0STEP-1:POKEV,Y:FORZ=1TO300:NEXTZ:NEXTY:POKEV,0:POKEV-1
,0
840 GOTO900
850 POKEV,15:FORY=1TO10:POKEX,200:FORZ=1TO10:NEXTZ:POKEX,0:FORZ=1TO100:NEXTZ:NEX
TY
860 GOTO100
870 FORZ=1TO999:NEXT
880 POKEV,15:FORY=1TO100:POKEX,INT(RND(1)*128)+128:FORZ=1TO100:NEXTZ:NEXTY
890 PRINT" * CONGRATULATIONS! * YOUR MISSION SUCCEEDEDYOU HAVE OUR GRATITUDE"
900 POKEV,0:POKEX,0:PRINT"■■■TO LIVE AGAIN PRESS R"
910 GETR$:IFR$=""THEN910
920 IFR$="R"THENRUN
```

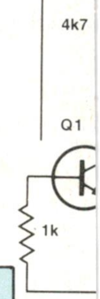
MYSTERY SHIP

P. C. Bagust, Sans Souci NSW

This is a rather interesting adventure game, in which you are invited to teleport onto a space ship that is drifting helplessly near earth. Unless you can stop it, it will crash into the earth, killing many people in the process.

The intrepid adventurer must explore the dark passageways of the ship, encounter hostiles, control the ship and finally earn the gratitude of the peoples of Earth.

VIC-20



CONTRIBUTORS PLEASE NOTE

All contributions to this column should be accompanied by a listing of the program from a printer. Hand written or typed listings are not acceptable.

There are two reasons for this. The first is that a listing from your computer gives us some guarantee that *you* have got the listing correct.

Secondly, if you present us with a neat final copy of your program we can use photographic techniques to reproduce it in the magazine, without risk of errors.

However, if you present us with a scrawl done on the back of someone's old fag packet it needs to be manually typed twice here, with consequent increase in labour on our part and increase in the probability of errors.

GRAPHICS CLOCK

B. Federsen, Ferntree Gully Vic 3156

This program requires and demonstrates some of the capabilities of the Super Expander. It depicts a clock face with a sweep second hand that shows the time. The clock ticks when the time is updated.

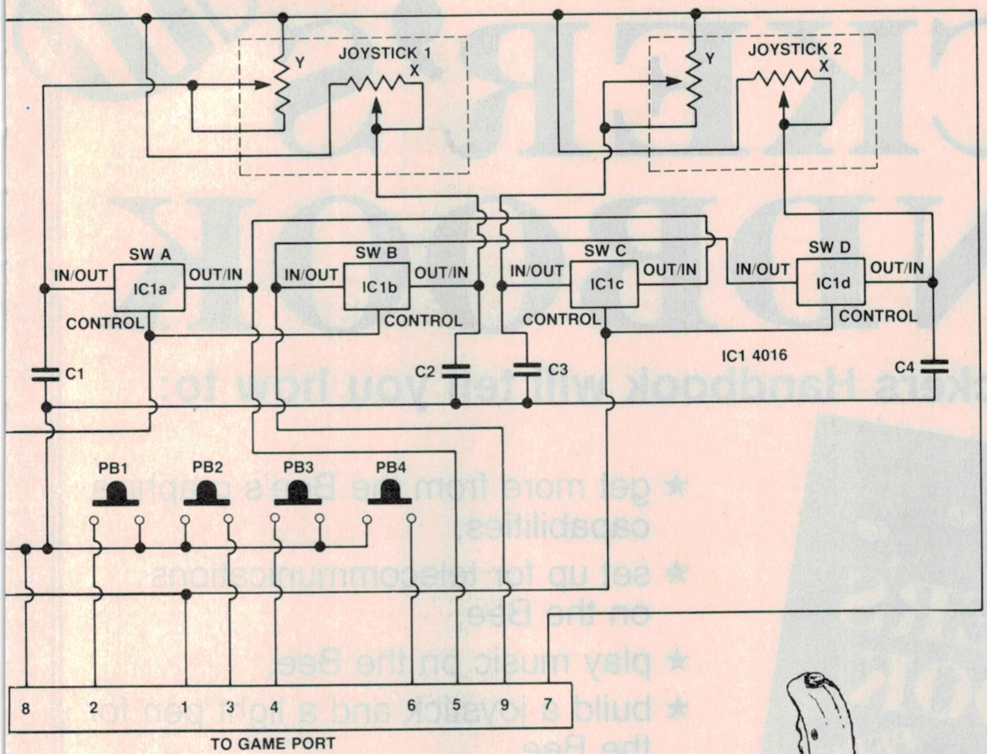
In statement 30 the clock has been defined as an ellipse but appears as a circle on the TV screen. Statements 120 to 230 sets the outer points for the second hand and uses a subroutine for drawing the second hand.

VIC-20

VIC-20 TWO STICK

JOYSTICK CONTROLLER

R. Nottage, Forrestfield WA 6058



Here is a simple circuit to give VIC-20 users the ability to play joystick games with two controls simultaneously. IC1 is a quad CMOS switch (4016). The two controls are simply switched under software control. Q1 is used as an inverter, and switches SWA and SWB off when SWC and SWD are switched on, and vice versa. PB1 and PB3 are fire buttons. PB2 and PB4 are extra for other uses such as bomb fire.

To control which joystick is in use:

a) POKE location 37139 with 4 to make Joy 0 an O/P and Joy 1, Joy 2 and L/Pen inputs.

b) POKE location 37154 with 127 to make Joy 3 an input.

c) POKE location 37137 with a high in bit 2 to switch on JS1 or a low for JS2.

d) PEEK bits 3, 4 and 5 for values for PBs 1-3.

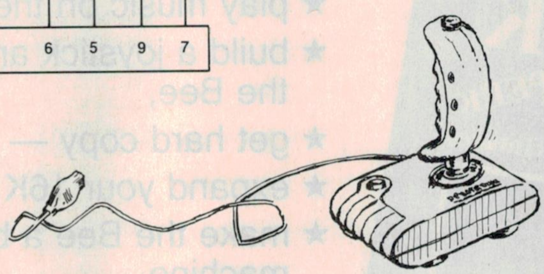
e) PEEK 37152 in bit 7 for PB4.

f) Digital value for selected joystick is in 36871 for X value and in 36872 for Y value.

Joystick values are 100k and C1 to C4 are .001 μF.

(NOTE: Some joysticks' resistance range can differ due to mechanical construction. The capacitor for that particular resistance can be changed to counteract this problem.)

PIN No.	FUNCTION
1	JOY0
2	JOY1
3	JOY2
4	JOY3
5	POT Y
6	LIGHT PEN
7	+5V (100 mA Max)
8	GND
9	POT X



```
10 REM GRAPHIC CLOCK
11 REM REQUIRES SUPER EXPANDER
12 GRAPHIC 0
14 INPUT"GIVE TIME 'HHMMSS'  ",A$:TI$=A$
16 GRAPHIC 1
20 COLOR 1,7,0,10
30 CIRCLE 2,511,511,200,300:REM THIS WILL
   APPEAR AS A CIRCLE ON TV
50 REM DRAW CORNER BOXES
60 DRAW1,0,0TO100,100
65 X=000:Y=100
69 DRAW3,X,XTOY,XTOY,YTOX,YTOX,X
71 A=923:B=100:C=1023:D=0
72 DRAW3,A,DTOA,BTOC,BTOC,DTOA,D
73 DRAW1,C,DTOA,B
75 DRAW3,A,ATOC,ATOC,CTOA,CTOA,A
76 DRAW1,C,CTOA,A
77 DRAW3,D,ATOB,ATOB,CTOD,CTOD,A
78 DRAW1,D,CTOB,A
80 DRAW1,0,0TO100,100
85 X=100:Y=922
90 DRAW3,X,XTOY,XTOY,YTOX,YTOX,X:REM DRAW MAIN BOX
91 PAINT 3,511,511
92 PAINT 2,200,200
95 REM SET CLOCK NUMBERS
96 CHAR1,09,"12"
97 CHAR15,09,"6"
98 CHAR09,06,"9"
99 CHAR09,13,"3"
101 REM SET SECOND HAND OUTER COORDINATES
102 S=511-000:T=511-000
104 U=511-410:V=511-313
106 W=511-394:P=511-400
108 R=511-380:Q=511-280
110 J=S+0:K=T-Q
115 TT=TI:TS=TI+63
120 L=S+0:M=T-Q:GOSUB10000:REM 12 O'CLOCK
130 L=S+U:M=T-V:GOSUB10000:REM  1 --
140 L=S+W:M=T-P:GOSUB10000:REM  2 --
150 L=S+R:M=T+0:GOSUB10000:REM  3 --
160 L=S+W:M=T+P:GOSUB10000:REM  4 --
170 L=S+U:M=T+V:GOSUB10000:REM  5 --
180 L=S+0:M=T+Q:GOSUB10000:REM  6 --
190 L=S-U:M=T+V:GOSUB10000:REM  7 --
200 L=S-W:M=T+P:GOSUB10000[REM  8 --
210 L=S-R:M=T+0:GOSUB10000:REM  9 --
220 L=S-W:M=T-P:GOSUB10000:REM 10 --
230 L=S-U:M=T-V:GOSUB10000:REM 11 --
240 GOTO120
999 END

10000 REM DRAW ROUTINE
10005 TT=TT+5
10020 IFTI<TT THEN10020
10030 DRAW3,511,509TOJ,K
10040 J=L:K=M
10050 DRAW1,511,509TOJ,K
10060 POINT2,511,509
10064 IFTS>TI THEN10170
10065 TS=TS+60
10066 AA$=MID$(TI$,1,2)+":"+MID$(TI$,3,2)+":"+MID$(TI$,5,2)
10070 CHAR19,6,AA$
10080 SOUND225,225,225,0,15
10090 SOUND0,0,0,0,0
10170 RETURN
```

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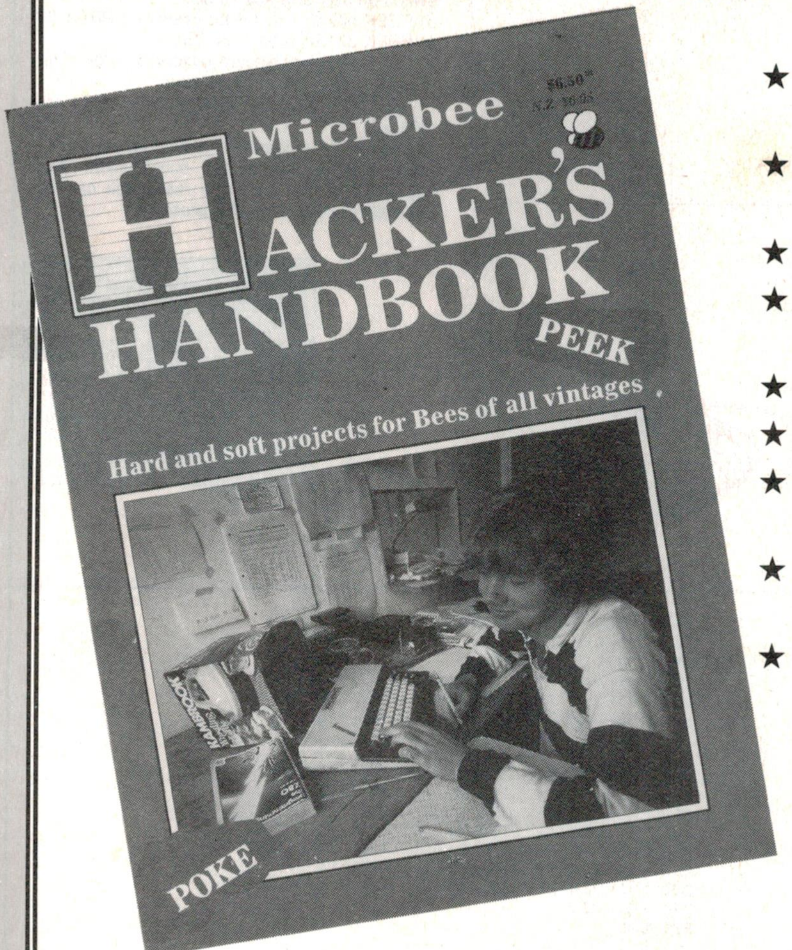

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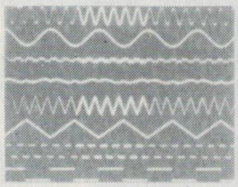
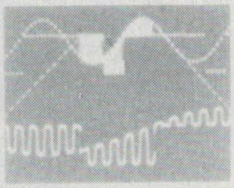


3 CHANNEL, 8 TRACE DISPLAY, displayed simultaneously or in selected combination.



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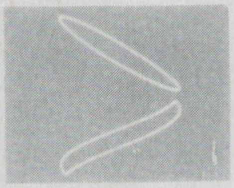

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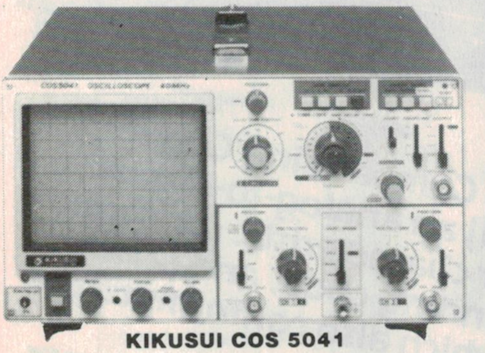

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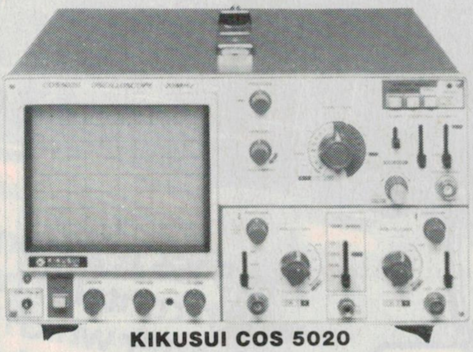

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DX SESSIONS — the fast way to find out what's happening

The international shortwave broadcasting scene is constantly changing. The best way to keep track of things is by tuning into the DX information sessions broadcast by the stations themselves.

Arthur Cushen

THE SHORTWAVE STATIONS have realised that they can publicise their own schedule changes and give information about new stations, frequencies and transmission information by incorporating this material in a regular DX session. These are now standard features of the programme schedule of almost all international broadcasters.

It was Australia that pioneered the DX session, with a programme first scheduled in July 1946. Unfortunately after a run of 31 years, the programme was withdrawn at the end of October 1977. The original concept was put together by three South Australian listeners, Ern Suffock, Jim Paris and Rex Gillett. Ern Suffock wrote the script and it was sent to Melbourne for broadcast.

Later Graham Hutchins commenced a regular session on Radio Australia, known as "Australian DXers Calling". In subsequent years the session was presented under various programme titles and became a part of "Club Forum" with Keith Glover till December 1980, then "Spectrum" with Dick Speekman and now is part of "Talkback" hosted by Barry Seeber.

At the same time, DX tips have been broadcast for many years in the Japanese Language Service of Radio Australia. During the period of the early 1950s, information for the shortwave listener appeared in print with Rex Gillett contributing a feature in "Radio Call" a programme magazine published in Adelaide, and Graham Hutchins in "Listener In" in Melbourne, but both these publications folded many years ago.

After the deaths of Ern Suffock and Jim Paris, DX information was centred in Melbourne. Contributions are now made to the programme by the Australian Radio DX Club.

Miss Yuka Nukina and Mr Hiroshi Shioguchi, comperes of Radio Japan's regular session 'DX Corner'.

In New Zealand the first regular DX programme went on the air in January, 1960 as part of Cleve Costello's "This Radio Age", a magazine feature of radio information. During the 1950s this writer contributed from time to time items of interest to radio listeners. "Arthur Cushen's DX World" became a 15 minute feature on Radio New Zealand and was carried not only on the shortwave service, but also on the national mediumwave programme.

During 1975 Radio New Zealand was off the air for some weeks but due to protest from listeners it returned with an expanded DX programme broadcast every two weeks. In 1980 "The DX World" became part of a special feature compered by Tony King, which included a segment in Japanese and this fortnightly session ended in May 1982 when the Government withdrew the subsidy to Radio New Zealand.

Today DX information in New Zealand is available on Radio Rhema on Friday at 1015 UTC and on 4XD at 0845 UTC on Sunday, on mediumwave. In the field of print material, in the 1940s the "Lamphouse Annual" provided a list of the main stations in the world, while a monthly publication, "Radiogram" gave listeners the latest news on shortwave broadcasting.

From July 1952 the writer has been contributing a column in the "NZ Listener" which has now been printed continuously for 33 years.

Longest Running Session

"Sweden Calling DXers" is the session with the longest continuous broadcasting history, commencing in February 1948. Arne Skoog was the founder of the programme and broadcast the session weekly until his retirement in 1981. The new compere is George Wood.

Radio Nederland has been voted the most popular DX session, which had its beginnings in the 1950s with Harry Van Gelder and DX Juke Box. During this time there were promotions of the hobby including special publications, DX courses and the like. Fritz Greveling and Dick Speekman continued the programme after Harry Van Gelder's retirement.

In 1977 Jonathan Marks the present compere, took over the session. Retitled "Media Network" in October 1980, it now incorporates a wide variety of information moving into computers, video material and other modern electronics. The DX contributions still remain a mainstay in the programme with news from the Pacific, Africa, Denmark and South Asia each Thursday, in that order. Other features include items on clandestine broadcasts, new receivers and station news.

Adrian Peterson, compere of the program 'Radio Monitors International' broadcast by Sri Lanka Broadcasting Corporation.

The BBC has also had continuous interest in the shortwave listener, although its programme could not be classed as a DX session but mainly news on BBC activities and help to listeners with technical questions. The late 1960s saw the introduction of BBC World Radio Club, with Henry Hatch and Reg Kennedy. After the Club was disbanded in 1980, it was replaced with "Waveguide", a weekly feature on BBC frequencies and reception conditions.

Radio Canada International has also a long interest in its shortwave audience. Radio Canada Shortwave Club was established in the 60s, with monthly technical bulletins featuring DX information and a weekly programme on shortwave with Ian McFarland. This programme ended on 1 November 1975 but later was revived with Ian McFarland and the "Shortwave Listener's Digest" — now a regular transmission each week from Montreal.

HCJB Quito Ecuador diversifies wider than the station's normal straight gospel programme, and in 1962 started "DX Party Line". After its initial introduction this was compered by Clayton Howard for 22 years, until last year when the new host John Beck became promoter of the feature. It has a regular DX contribution from the South Pacific in the third Monday of each month's transmission and recently returned to a three times a week programme.

Australia's nearest neighbour with a DX session is KTWR Agana Guam, with its "DX Listeners' Log" broadcast weekly. It is part of the schedule of a relatively new station, opened in September 1977 and includes contributions from many listeners including a monthly feature from the South Pacific Association of Radio Clubs. This is compered by Keith Barton of Adelaide.

Radio Budapest Shortwave Club is one of the best known from Eastern Europe. This club issues a monthly magazine with technical articles, information on problems, some of them being solved by readers and DX tips from contributors mainly from Europe. RBSWC issues an annual membership certificate and honours its long-standing listeners with life membership by the award of an attractive plaque.

Radio Japan's "DX Corner" has been a feature of the Tokyo programmes for many years and has recently been expanded and given its own slot in the schedule. Broadcasts on Saturday 0915-0930 UTC include DX tips, sunspot information and technical articles.

Swiss Radio International has "Swiss Shortwave Merry-go-Round" on the air every second and fourth Saturday, with presenter Bob Tulman, who has been with the programme for over 20 years. Bob Zinotti also shares the presentation. Both are radio amateurs, so the programme has a more technical touch. It has contributions of DX news from Noel Green of England, features a mystery sound on shortwave and the latest sunspot count and predictions.

"Radio Monitors International" is featured from the Sri Lanka Broadcasting Corporation. The programme is recorded at AWR studios in Poona, India by Adrian Peterson and is carried from the Colombo station each week. The broadcast is also carried on exchange from Radio Canada and WRNO New Orleans, giving it a much wider audience than South Asia and the Pacific. The 30-minute weekly session has a station profile each week with background. The much-travelled compere of the session is in the position to record many of the world's unique and seldom heard broadcasting stations when involved in his missionary work.

CURRENTLY AVAILABLE DX SESSIONS

Sunday	
0200 UTC	Radio South Africa 9615 kHz
0210	Radio Australia 15240 kHz
0620	Radio Moscow 15130 kHz
0900	Radio Austria 15270 kHz
0900	Adventist World Radio, Portugal 9670 kHz
1910	Radio Belgium 15590 kHz
Monday	
0030 UTC	Radio Belgium 9925 kHz
0305	Radio Canada 9755 kHz
0400	Radio Sofia, Bulgaria 11750 kHz
0550	Radio Exterior, Spain 9630 kHz
0915	BBC London 11750 kHz
0930	HCJB, Quito 6130 kHz
1040 (1st and 3rd)	India, AIR 17705 kHz
Tuesday	
0050 UTC	Radio Moscow 12010 kHz
1115	Radio Sweden 17820 kHz
Wednesday	
0400 UTC	Radio Sofia, Bulgaria 11750 kHz
0400	Radio Budapest, Hungary 9832 kHz
0700	HCJB, Quito 9745 kHz
1915	Radio Belgium 15590 kHz
2000	Radio Prague, Czechoslavakia 7345 kHz
Thursday	
0030 UTC	
0750	
1050	
Friday	
0100 UTC	Radio Prague, Czechoslovakia 11990 kHz
0300	Radio Prague 11990 kHz
0550	Radio Nederland 9895 kHz
Saturday	
0043 UTC	KTWR Guam 17790 kHz
0400	Radio Budapest, Hungary 9835 kHz
0705	Swiss Radio International 9650 kHz
0905	Swiss Radio International 15570 kHz
0915	Radio Japan 11875 kHz
0930	HCJB Quito Ecuador 6130 kHz
0958	KTWR Guam 11840 kHz
1530	KTWR Guam 9535 kHz
2135	Radio Canada 15325 kHz

This item was contributed by Arthur Cushen, 212 Earn St., Invercargill New Zealand, who would be pleased to supply additional information on medium and shortwave listening. All items quoted are UTC (GMT) 10 hours behind Sydney time, all frequencies are in kilohertz (kHz). In areas observing daylight time, add a further hour. ●

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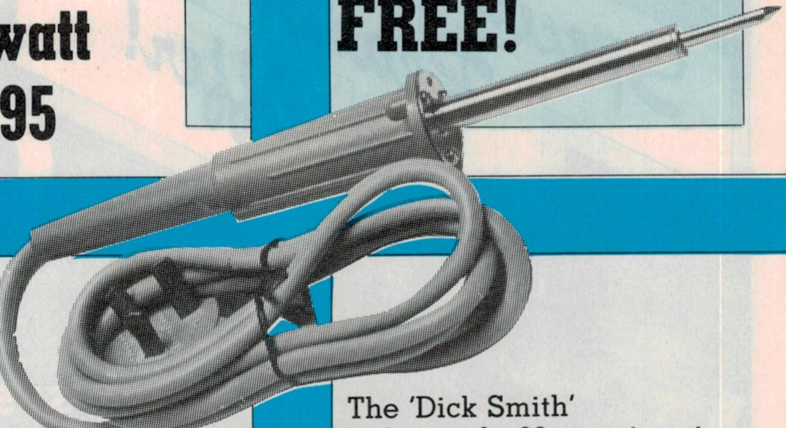

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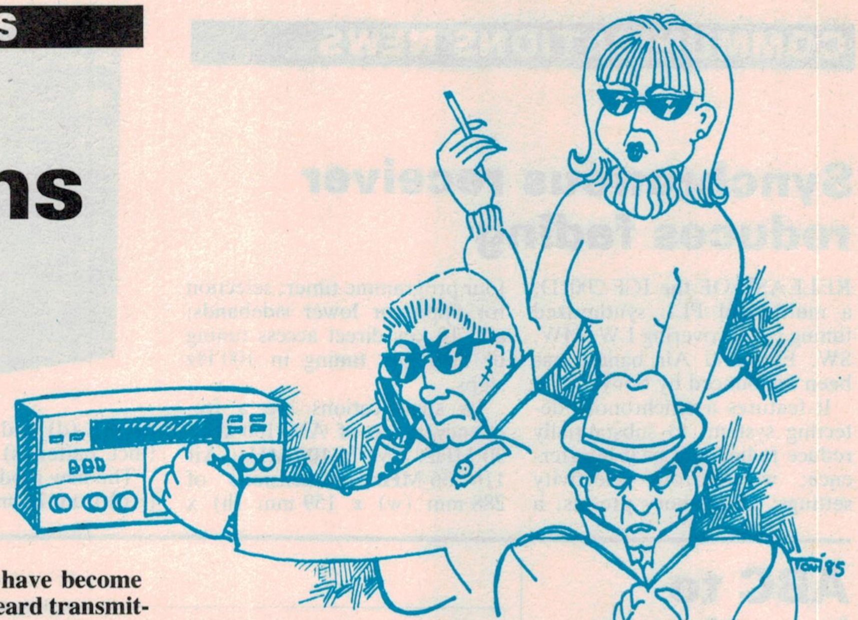
Spy stations create intriguing listening



OVER THE past few years shortwave listeners have become aware of an unusual type of broadcaster who is heard transmitting coded messages.

So called number stations are heard in German, Spanish, English, Korean and Czech on various out of band channels on shortwave. The first was the German number station which broadcasts from East Germany and carrying coded messages for agents in Western Europe. Spanish broadcasts soon followed originating from Cuba, presumably for agents in Latin America. Korean, from North Korea to agents in South Korea and broadcasts in Czech to Western Europe have also been heard. The English message service is a relative newcomer in the field of undercover information.

According to Bob Grove in his publication *Shortwave Directory* many countries of the world utilise the shortwave spectrum for sending coded broadcasts to resident agents. These are most often heard as four or five digit number groups in a female voice in the native language of the intended recipient. The voice has a mechanical rhythm to it due to the method in which it is sent: a keyboard selects the recorded voice one character at a time.

The format is similar for most countries: a callup ("attention") is followed by a three-digit address (agent's identification) then a group count (number of groups in the message to follow). After the text is broadcast, "finale" or "end of message" may be heard.

Many frequencies are paired, simulcasting the message to assure reception in case of interference or propagational problems. Often the same message is repeated on another frequency immediately after the first transmission. Messages identical in content are sometimes sent months later, indicating possible phantom traffic for practice or diversionary dis-information.

Most schedules are on quarter hours, with on the hour being the commonest. While full carrier AM is still heard, there is a gradual trend towards reduced-carrier upper sideband. Occasional Morse code groups alternate with the voice broadcasts.

A variant on the numbers stations is the phonetic broadcaster and recent reports suggest the origin of these transmissions to be the Israeli "Mossad" intelligence organisation.

Speculation on the content of numbers messages is varied, but they probably contain routine itinerary information for field agents behind foreign borders. They are decoded using a one-time pad which cannot be broken by computer analysis.

A recent comprehensive list of numbers stations transmissions is available from Grove Enterprises Inc, Brasstown NC 28902, USA.

— Arthur Cushen

13 MHz band to be created

THE RECENT World Administrative Radio Conference was faced with the problem of too many stations for too few frequencies, so an expansion of the shortwave bands was inevitable.

All the bands are being expanded from 6 to 21 MHz, while the 25 MHz band is to suffer a reduction. A new band being created is the 13 MHz band between 13.6 MHz and 13.8 MHz.

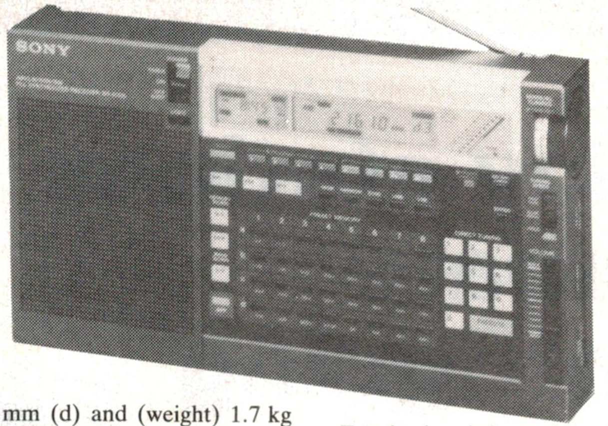
Recent surveys show that there are 163 countries operating on shortwave with a total of about 1500 shortwave transmitters in operation. In the international broadcasting field there are 100 countries operating an external service, and it is presumed they operate about 16 hours a day which means that an average of 1000 transmitters are in operation at any given moment of the day, according to Jim Vastenhound of Radio Nederland.

The expansion of the shortwave bands is to take effect in 1989, but already the new 13 MHz band is being used by eight countries. Radio Moscow has shown the greatest interest in this band and has been received on seven frequencies, while other countires noted are Pakistan, South Korea, Iraq, Holland, Israel, Iran and Iceland.

Monitoring observations show the following frequencies are being used in this new band:

13600 kHz USSR, Radio Moscow;
13605 kHz Radio Pakistan, Islamabad;
13625 kHz USSR, Radio Moscow;
13635 kHz USSR, Radio Moscow;
13645 kHz USSR, Radio Moscow;
13650 kHz USSR, Radiò Moscow;
13660 kHz USSR, Radio Moscow;
13665 kHz South Korea, Radio Korea, Seoul;
13670 kHz South Korea, Radio Korea, Seoul;
13670 kHz Radio Nederland, Flevoland;
13680 kHz USSR Radio Moscow;
13700 kHz Iraq, Radio Baghdad;
13720 kHz Israel, Israel Broadcasting Authority, Tel Aviv;
13745 kHz Iran, Radio Iran, Teheran;
13797 kHz Iceland, Iceland State Broadcasting Service, Rejkjavik.

— Arthur Cushen



Synchronous receiver reduces fading

RELEASE OF the ICF-2001D, a multi-band PLL synthesized tuning radio covering LW, MW, SW, FM, and Air bands, has been announced by Sony.

It features a synchronous detecting system, to substantially reduce fading and beat interference; wide/narrow selectivity settings; 32 memory presets; a four programme timer; selection for upper or lower sidebands; and 10 key direct access tuning or analogue tuning in 100 Hz steps.

Its specifications are a frequency range of AM 150 kHz-30 MHz; FM 76-108 MHz; Air 116-136 MHz; dimensions of 288 mm (w) x 159 mm (h) x 52 mm (d) and (weight) 1.7 kg (incl. batteries).

The new model retails at $499 (rrp) from February.

For further information contact **Sony (Australia) Pty Ltd. (02)887-6666.**

ABC to broadcast on HF band

A NEW high-frequency (short-wave) radio service to be introduced this year means that for the first time ABC radio will be heard throughout the Northern Territory.

The Minister for Communications, Mr Michael Duffy, has announced that three high-powered (50 000 watt) transmitting stations would be used to provide the new service.

They would be sited at Alice Springs, Tennant Creek and Katherine and each would have a range of approximately 240 km in all directions.

"Programs for the service will originate in the Darwin and Alice Springs studios of the ABC," Mr Duffy said. "For most of the time they will be the same as programs broadcast on the present medium-frequency stations — 8DR (Darwin), 8AL (Alice Springs), 8G0 (Nhulunbuy), 8JB (Jabiru), 8KN (Katherine) and 8TC (Tennant Creek).

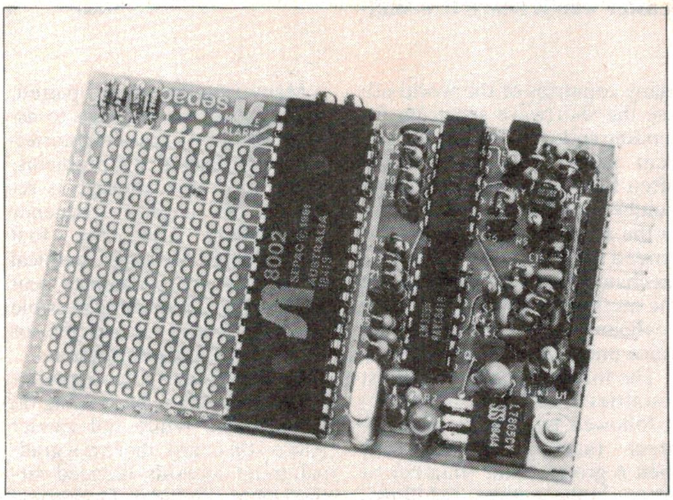
"The ABC does have plans however to include segments of special interest to remote areas."

The Minister said the cost of the new service was estimated at $3.8 million.

He advised people thinking of buying new radio receivers to look for those providing short-wave reception on the following bands:

120 metres (2.3 to 2.5 MHz), 90 metres (3.2 to 3.4 MHz), 60 metres (4.8 to 5.0 MHz), 49 metres (6.0 to 6.2 MHz), 31 metres (9.5 to 9.8 MHz).

Printed selcal circuit board level



A NEW pc board level selcal module has been added to Sepac's increasing range of selective calling products.

The S370 pc board is small enough to fit internally to most two way radios thus allowing, via a single switch operation, selective calling (selcal) on either a fleet or individual address basis.

Based on Sepac's reliable SI8002 microprocessor signalling IC, this pc board allows normal quiet operation of the mobile, or base station, within the fleet until decode of an individually addressed selcal.

Benefits of this 'state of the art' pc board include, on return of the operator to an unattended mobile, a visual indication of the decode displayed and an audible indication to the caller that their selcal has been received, decoded and stored

Selection of all five tones of the receive and transmit codes, plus selection of tone periods, lead in delay, tone format and other features are achieved by simple solder bridging of the code matrix, eliminating the necessity to cut tracks and add components as in other inexpensive selcal pc boards, thus reducing error, fitting time and eliminating time consuming circuit diagram examination.

All enquiries to **Sepac Industries (Australia) Pty Ltd, 134 Beach St, Frankston, Vic 3199. (03)781-3144.**

Amateur radio award

THE GEELONG Radio and Electronic Society is introducing a new award to be named the "City by the Bay" award after the slogan of the city of Geelong.

The award will be issued to an entering club station depending on how many points the station can accrue for contact with club station VK3ANR, contact with club members (mobile) and contact with fixed station club members. Interested clubs must keep and submit a record in log form and have their contacts confirmed.

For further information about the Geelong Radio and Electronic Society or the "City of the Bay" award, contact **Roy Whitside, Awards Manager, 11 Carinya Ave, Newcomb, Vic 3219.**

2 kilowatt dummy load

GFS ELECTRONIC Imports recently announced the availability of a 2 kw oil cooled 50 ohm dummy load from MFJ Enterprises. Known as the MFJ-250 the load is rated at 2 kW PEP and 1 kW CW for 10 minutes. A full derating curve is supplied with each unit.

The MFJ-250 exhibits a usable VSWR up to 400 MHz. For example, VSWR is less than 1.2:1 over 0 to 30 MHz, less than 1.5:1 over 30 to 300 MHz and less than 2.1, 300 to 400 MHz. Only high quality industrial transformer oil is supplied with the MFJ-250. Power input to the load is via an SO-239 coaxial connector mounted on top. A safety vent is also incorporated in the lid. Price of the MFJ-250 is $71 plus $12 freight.

For further information contact **GFS Electronic Imports, 17 McKeon Rd, Mitcham 3132. (03)873-3777.**

New 720 channel transceiver

A NEW 720 channel synthesised hand-held airband transceiver was recently released by GFS Electronic Imports. Manufactured in Japan and known as the ATC-720X it is approved for use within Australia by the Department of Communications.

Facilities featured on the ATC-720X include 25 kHz channel steps using thumbwheel selectors over a receive-only range of 108.000 to 117.950 with the transceiver range extending from 118.000 to 136.000. This constitutes 720 channels for communication and 200 channels for monitoring VORs. Three memories are provided which are user selectable. The memories as well as the dial frequency may be scanned by the use of inbuilt scanning circuitry. Transmitter power is selectable from 200 milliwatts to 1 watt.

The ATC-720X is supplied complete with a flexible rubber duck antenna. It accepts six AA Alkaline batteries or an optional nicad battery pack as a power source.

Size is 192 m x 66 mm x 40 mm (62 mm at top) and weight is 400 grams not including the batteries. Its case is made from high impact resistant ABS plastic.

For further information contact the Australian distributors **GFS Electronic Imports, 17 McKeon Road, Mitcham, Vic. (03)873-3777.**

SPECIAL ETI READER OFFER

DIGITAL MULTIMETERS

FROM BENELEC

THREE MODELS TO CHOOSE FROM —

All 3½-digit LCD Meters Featuring 0.5% (dc) Basic Accuracy 'Professional' Instruments at a Hobbyist Price!

BENELEC PTY LTD had such a resounding success with a previous offer made through Electronics Today that they approached us about launching **two new multimeters** in their Univolt range in the same way.

Univolt is **no new brand** to the Australian market. BENELEC has been distributing Univolt multimeters here for the past five years. The instruments are designed, developed, manufactured and marketed under the company name — no 'badge' engineering here. These meters are **imported exclusively by BENELEC PTY LTD** who warranty and service them here. They've been in the electronics business for over eight years and believe in handling quality products.

Here's an incredible opportunity to get the sort of multimeter to suit your needs at virtually unbeatable prices!

Univolt's continuing design and development program has brought two new models to the marketplace and this is the first time the DT-1000 and PD-1800 models have been offered here. The DT-860 was first offered two years ago and, as a sort of 'anniversary deal', Benelec are again offering the DT-860, but this time at a lower price!

DON'T MISS OUT — ORDER NOW!

Send completed coupon to:
Federal Marketing, BENELEC/ETI Multimeter Offer,
PO Box 227, Waterloo NSW 2017.

I don't want to miss out on this special offer. Please rush me the following:

.... DT-1000 Multimeter(s) at $ ....
.... PD-1800 Multimeter(s) at $ ....
.... DT-860K Multimeter(s) at $ ....
Sales Tax No: .... (if applicable)
Please add $2.50 post and handling per unit ordered.
TOTAL $ ....
(allow up to four weeks for delivery)

Name ....
Address ....
.... **Postcode** ....
Signature...
American Express ☐ **Bankcard** ☐ **Cheque*** ☐
** Please make cheques payable to the Federal Publishing Company Pty. Ltd.*
Credit Card No:

Expiry Date: ....

OFFER CLOSES LAST MAIL SUNDAY 31 MARCH

◄ DT-860K AUTORANGING DIGITAL MULTIMETER

This popular LCD readout digital multimeter features 25 measurement ranges with autoranging on dc and ac volts and resistance. It incorporates a transistor gain measurement function as well as diode and continuity check functions. It comes complete with a carry case, 'safety' probes and transistor h_{FE} clip-probe. All for only: **$70** (tax exempt); **$90** tax paid.

3½-digit LCD readout (1999 max.); dc voltage ranges — 200 mV, 2, 20, 200, 1000, 0.5% basic accuracy' ac voltage ranges — 2, 20, 200, 750 V, basic accuracy 0.75%; dc and ac current ranges — 2, 200 mA, 10 A, basic 1% dc and 1.2% ac accuracy; resistance ranges — 200, 2k, 20k, 200k, 2M, 20M, 0.5% basic accuracy; transistor h_{FE} (NPN or PNP) to 1999 with V_{CE} of 1.2 V, I_B of 1 μA; diode check reads forward voltage drop; continuity check sounds buzzer under 20 ohms; overload protected; power supply – 2 x 1.5 V (AA) cells (inc.).

▲ NEW! UNIVOLT DT-1000K DIGITAL MULTIMETER

Univolt's top-of-the line handheld LCD multimeter. It features 30 measurement ranges, including dc volts, ac volts, dc and ac current, transistor h_{FE} (gain) plus diode check and audible continuity check (beeper). Range selection is via the single large rotary switch. The case features a prop-up stand and the whole unit comes with carrying case, probes and h_{FE} clip-probe for just: **$73.40** (tax exempt); **$95** tax paid.

3½-digit LCD readout (1999 max); dc voltage ranges — 200 mV, 2, 20, 200, 1000 V, 0.5% basic accuracy; ac voltage ranges — as for dc but 750 V on top range, basic 1% accuracy; dc and ac current ranges — 200 μA, 2, 20, 200 mA, 10 A, 1% basic accuracy on dc, 1.2% on ac; input impedance — 10M; resistance ranges — 200, 2k, 20k, 200k, 2M, 20M, 1% basic accuracy; transistor h_{FE} (NPN or PNP) to 1000 with V_{CE} of 2.0 V, I_B of 10 μA; diode check reads forward voltage drop; continuity check sounds buzzer under 20 ohms; overload protected; power supply — 9 V No. 216 battery (inc.).

▲ NEW! UNIVOLT PD-1800 DIGITAL PROBE TESTER

Wow! — a tiny digital volt-ohm-continuity probe with the 3½-digit LCD readout built-in! Great for the toolkit, great for the beach! It features autoranging on volts and ohms as well as autopolarity indication. A beeper sounds in the continuity test mode. There are four dc and ac voltage ranges and four resistance ranges. It measures a tiny 163 mm long, 28 mm high and 19 mm deep! How much? **$50** (tax exempt); **$65** tax paid.

3½-digit LCD readout (1999 max.); ac and dc voltage ranges — 2, 20, 200, 500 V, basic accuracy 0.5% dc, 1% ac; resistance ranges — 2k, 20k, 200k, 2M, basic accuracy 0.7% (in-circuit test capability — uses 0.3 V on ohms range); input impedance — above 10M; power supply — 2 x 1.5 V (LR-44) cells (inc.).

This offer is exclusive to readers of Electronics Today and products can only be obtained by sending in the attached coupon (or a clear photostat or hand-copied facsimile). **90 DAY WARRANTY ON ALL METERS** (from date of despatch).

SHOP AROUND

ETI-280 Low battery indicator

This is a reasonably simple project, designed for the most part with of-the-shelf components. You should have little trouble getting hold of them. In Melbourne the **Rod Irving** organization will be selling it in kit form for $7.95. In Perth, **Altronics** will do you a deal for $7.50.

ETI-182 Digital luxmeter

This project can measure light levels from 1 to 20k lux. The only problem you are likely to have is with the photodiode, a BPW21 distributed by **Promark** in Sydney. Kits from **Rod Irving** $75.

ETI-1405 Stereo enhancer

The biggest project of the month. It's designed to add a little extra oompa to your sound system. Cost of a **Rod Irving** kit is $114.95. The LED array and most of the parts will be available from **Jaycar** in Sydney. In Perth **Altronics** is selling the kit for $69.50.

Artwork

Making your own pc boards? Full-size positive or negative film is available for the prices listed below. Send requests, with payment, to: ***ETI-xxx Artwork, ETI magazine, PO Box 227, Waterloo, NSW 2017.*** Make sure you specify positives or negatives, according to the process you use. Make cheques or money orders payable to 'ETI Artwork Sales'. Here are the prices for this month's projects.

ETI-182	**pc board**	**$2.10**
	front panel	**$3.00**
ETI-1405	**pc board (a)**	**$3.90**
	(b)	**$3.50**
	front panel	**$6.15**
	rear panel	**$2.70**
ETI-280	**pc board**	**$1**

MINI MART

COMPUTERS

FOR SALE: MICROBEE 32K PC. Wordbee, Network MOW, games $450. Sony U-matics, 3800 P portapack, p/supply, batteries $500. 1210 player $250. M. Hartman . (02)630-6313.

WANTED: SYSTEM 80 Technical manual. David Gerard, 17 Simper St, Wembley 6014. (09)387-6578.

WANTED: CIRCUIT manual for Grundig Satellite 2000, also service manual for Barlow Wardley XR-30. Will return. J. Hunter, 1 Moonlight Ave, Torquay 4657. (071)28-1795.

WANTED: NEC 8043 colour monitor. Contact Alan Ker, Lot 15 Panoramic Dve, Grantville, Vic. 3834.

WANTED: LISTING or copy of Synertek KTNM-2/80, 80 column terminal, program and char. gen., ROMs. A Dunn, 28 Stonehouse Ave, Camden Pk, SA 5038. (09)295-8642.

AUDIO

FOR SALE: Toshiba KT-R2 'Walkman' type cassette recorder. Includes FM radio, metal/chrome facility, built in stereo mic. and jacks, carry case/strap. As new. $50 ono. Ring Geoff Pack (02)427-6304.

FOR SALE: B&W DM70 electrostatic speakers, recently recond woofers and electrostatic panels $500 pr. Will deliver. Transcriptor Fluid Anm instructions $65. Koss 9B electrostatic headphones with energiser $250. (02)869-1840.

MISCELLANEOUS

WANTED: Copy of 80 MICRO, issue with Bar Codes or UPC featured on cover and in mag, approx. Oct-Dec 83. A. Watson 'Ballambee' Cassilis Road, Mudgee 2850.

FOR SALE: TEKTRONIX 442 35 MHz, dual channel, single timebase CRO. 4 yrs old, excellent condition. $1200. Steward Dibbs, (02)807-4185 (h).

FOR SALE: 24 ETIs, 5 EAs 1978-83 plus 2 Capstan component draws with components plus some electrical/electronic junk. $30 the lot. Ring Geoff Pack, (02)427-6304.

FOR SALE: 1 X BWD 539D $500 — ono. K. Welch, 26 Petaine St, Raceview, 4305, Qld. (07)281-6480.

YOUR DREGS HACK sought far and wide for an idea for this month's issue. Without success. The electronics industry has spent a sane, happy month, watching the money roll in, smiling, smiling, all the way to the bank.

Overseas things have been bubbling along as usual. Some of the press releases that have crossed this desk are slightly more bizarre than others. For instance, in the UK, the competitor to British Telecom, Mercury Communications has bought an old hydraulic company. Apparently, the London Hydraulic Power Company used to supply water to run machines throughout London. At its peak the company was supplying 7.2 billion litres of water a year to more than 8000 machines.

Even in the nation that invented the Luddites, things do change. The King is dead, long live the King. So Mercury has decided to lay its fibre optic links in the water conduits so thoughtfully provided by the hydraulic company. The deal gives Mercury access to more than 270 miles of conduit beneath the city streets. Eat your heart out Telecom.

And mystery continues to haunt us. Consider this, dear readers: above your heads, right now, lurks the lonely celestial flasher. In spite of the best efforts of scientists too numerable to mention, the whereabouts, indeed the very nature, of the flasher remains a mystery.

All that is known is that on rare occasions, gamma ray and optical pulses of light can be detected coming from the Large Magallenic Cloud. What might cause these pulses, or why, appears a mystery. Astute readers of this column will realize the answer is obvious: Eccles is out there, mournfully flashing his torch around, singing, dirge-like: "show me the way to go home . . ."

Finally, universities around the place have finally released their results, and their load of bug eyed, blinking students into the sunshine of an unsuspecting world. Among the current crop of hopefuls: one Robert Irwin, fashionable young man about town and design engineer with an upmarket electronics magazine. He now insists on being called Mr Irwin by those of his colleagues who are not BSc, BE.

Robert is now busy working on a list of errata for all the projects he designed before he was an engineer. If you phone our technical enquiries number and ask for him personally, you'll get an intelligent answer, but only on evenly dated Tuesdays immediately before the full moon.

Now! $1495*

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One source: Hewlett-Packard

If putting a big dent in your instrumentation budget is not for you, the HP 3478A should prove ideal for your bench or system automatic measurements. For only $1495* you get a fully loaded six function DMM with HP-IB–not just a starter unit you have to pay later to upgrade.

All the right features plus HP-IB.

You can measure dc volts, RMS ac volts, dc current, RMS ac current, and 2- and 4-wire ohms. Plus, the HP 3478A is a fully programmable HP-IB system instrument. You have the convenience of switchable front/rear terminals, scanner advance, and external trigger input. You can even automate the HP 3478A's built-in electronic "no pots" calibration.

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When it comes to reliability, the HP 3478A is one of the best. Our field-proven reliability figures indicate over 50,000 hr MTBF (equal to 25 operational years).** So intensive is our attention to quality, from design right through production, that once you install your HP 3478A chances are you won't have to repair it or worry about it for the life of your system.

Call HP today.

For full details on the cost-cutting reliability leader HP 3478A DMM, fill in the business reply paid card coupon opposite or ring your nearest HP office listed: Melbourne: 895 2895; Adelaide: 272 5911; Perth: 383 2188; Brisbane: 30 4133; Canberra: 80 4244; Sydney: 888 4444; Auckland: 68 7159.

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